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Chung

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(54) **DIGITAL MACHINEGUN OPTIC WITH BULLET DROP COMPENSATION MOUNT**

(71) Applicant: **International Trade and Technologies, Inc.**, McLean, VA (US)

(72) Inventor: **Sung Giu Chung**, McLean, VA (US)

(73) Assignee: **International Trade and Technologies, Inc.**, McLean, VA (US)

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Related U.S. Application Data

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(60) Provisional application No. 61/565,387, filed on Nov. 30, 2011.

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F41G 1/30 (2006.01)
F41G 1/34 (2006.01)

(52) **U.S. Cl.**
USPC **42/113**; 42/119

(58) **Field of Classification Search**
USPC 42/111, 113, 122, 123, 130
See application file for complete search history.

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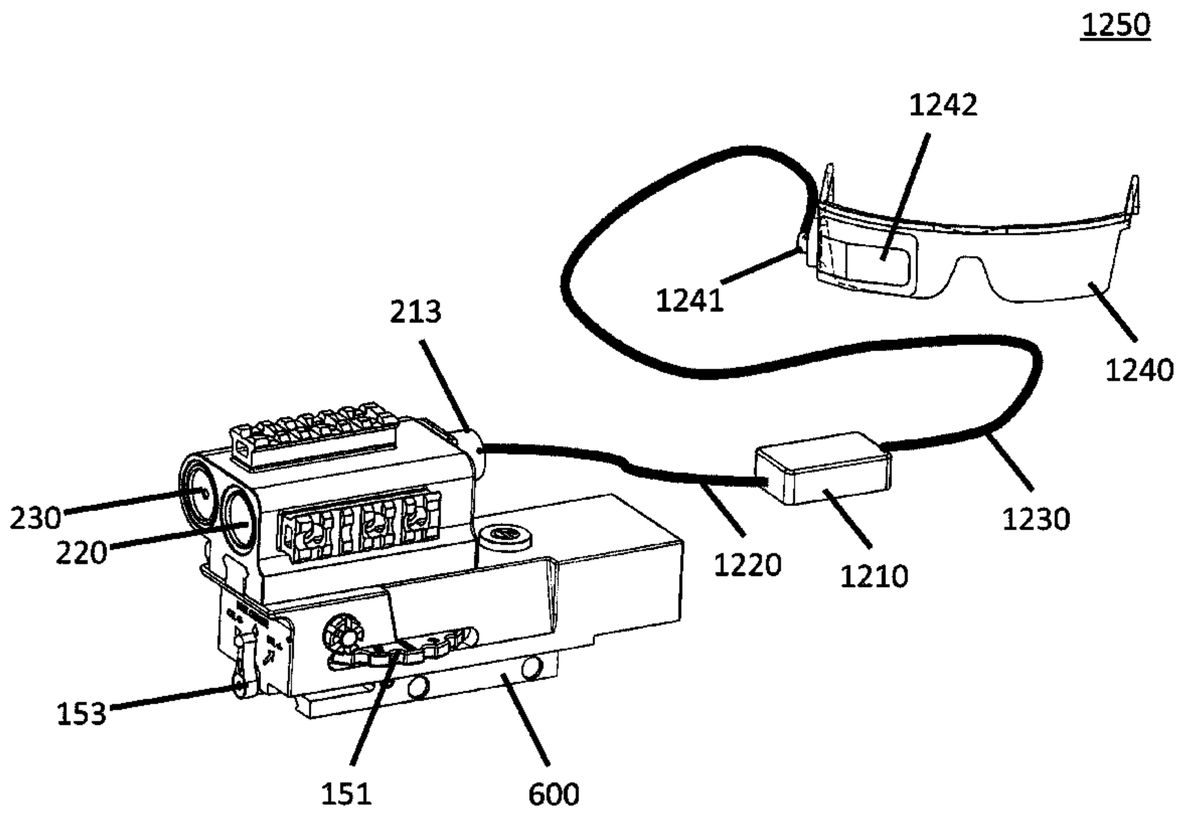
Primary Examiner — Bret Hayes
(74) *Attorney, Agent, or Firm* — Birch, Stewart, Kolasch & Birch, LLP

(57) **ABSTRACT**

A digital machinegun optic (DMO) is discussed, which includes a digital module having a camera to obtain an image, a bullet drop compensation mount receiving the digital module in a detachable manner, and having a mounting solution, a caliber adjustment knob configured to enable a user to select a caliber that matches firearms of different calibers, and a dual bullet drop compensation wheel to allow the user to accurately hit a target by selecting a right distance to the target; a head mounted display module having a display portion to receive the image from the camera; and a control box module configured to control a display of the image on the display portion.

15 Claims, 20 Drawing Sheets



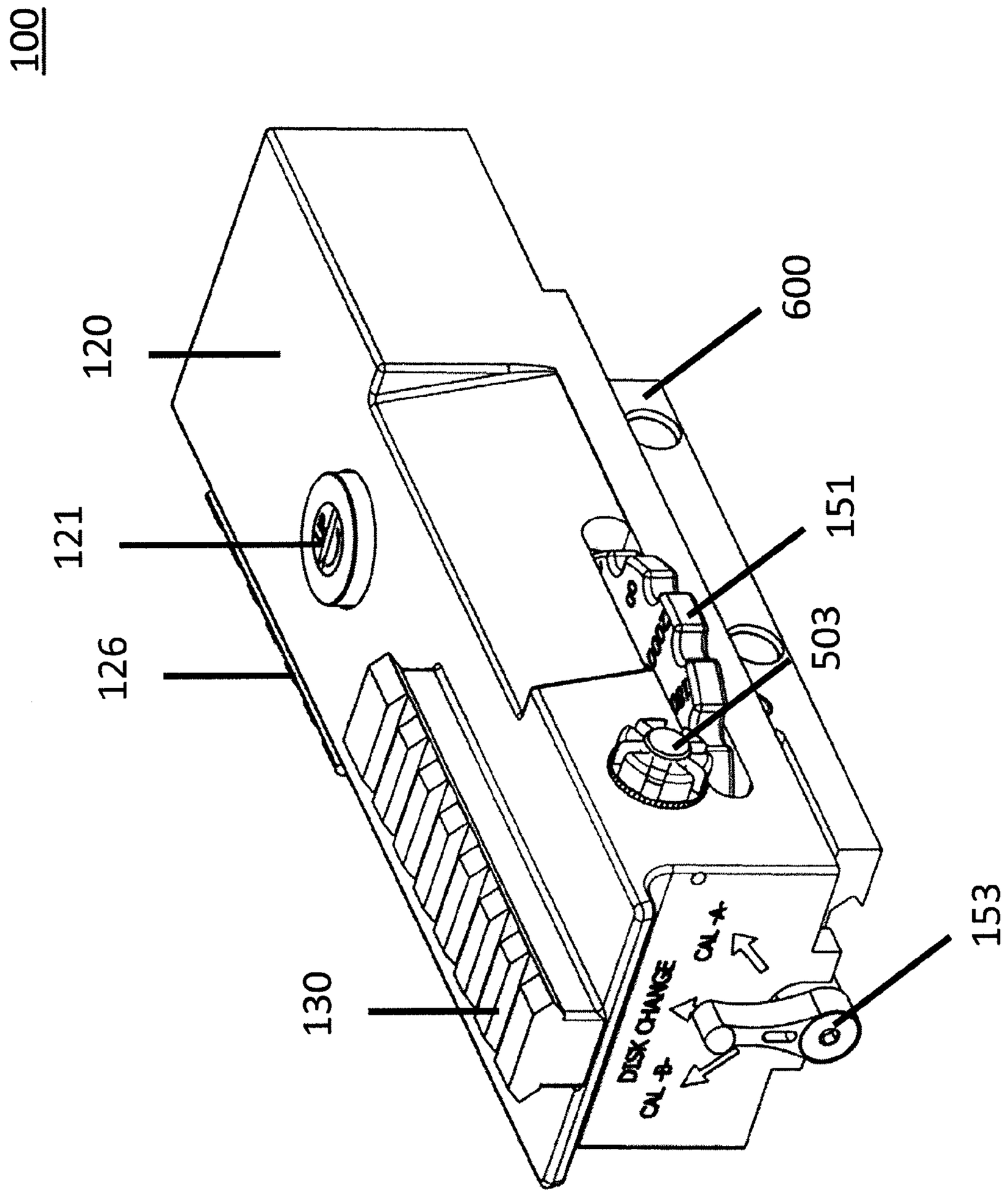


FIG. 1

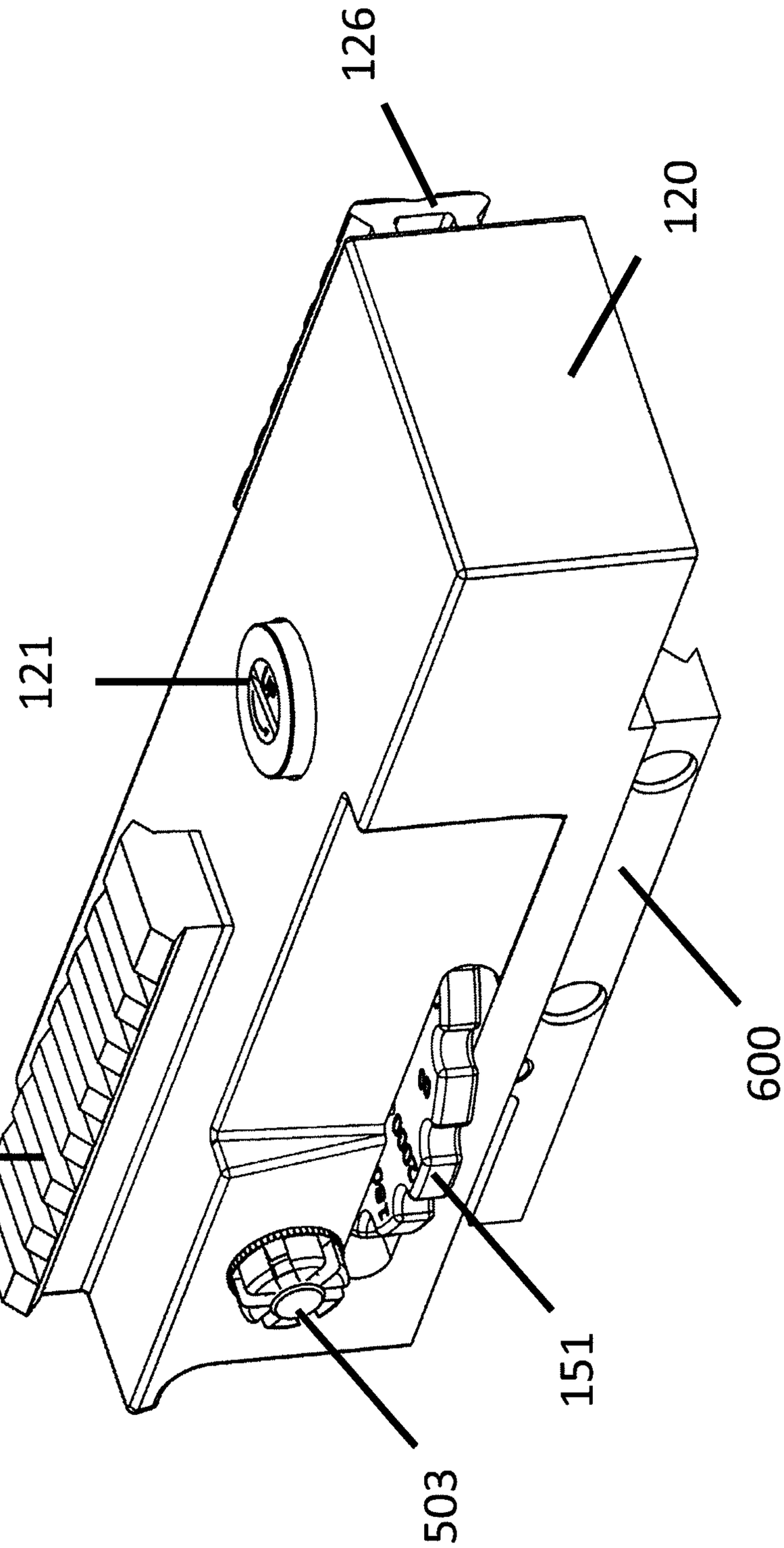


FIG. 2

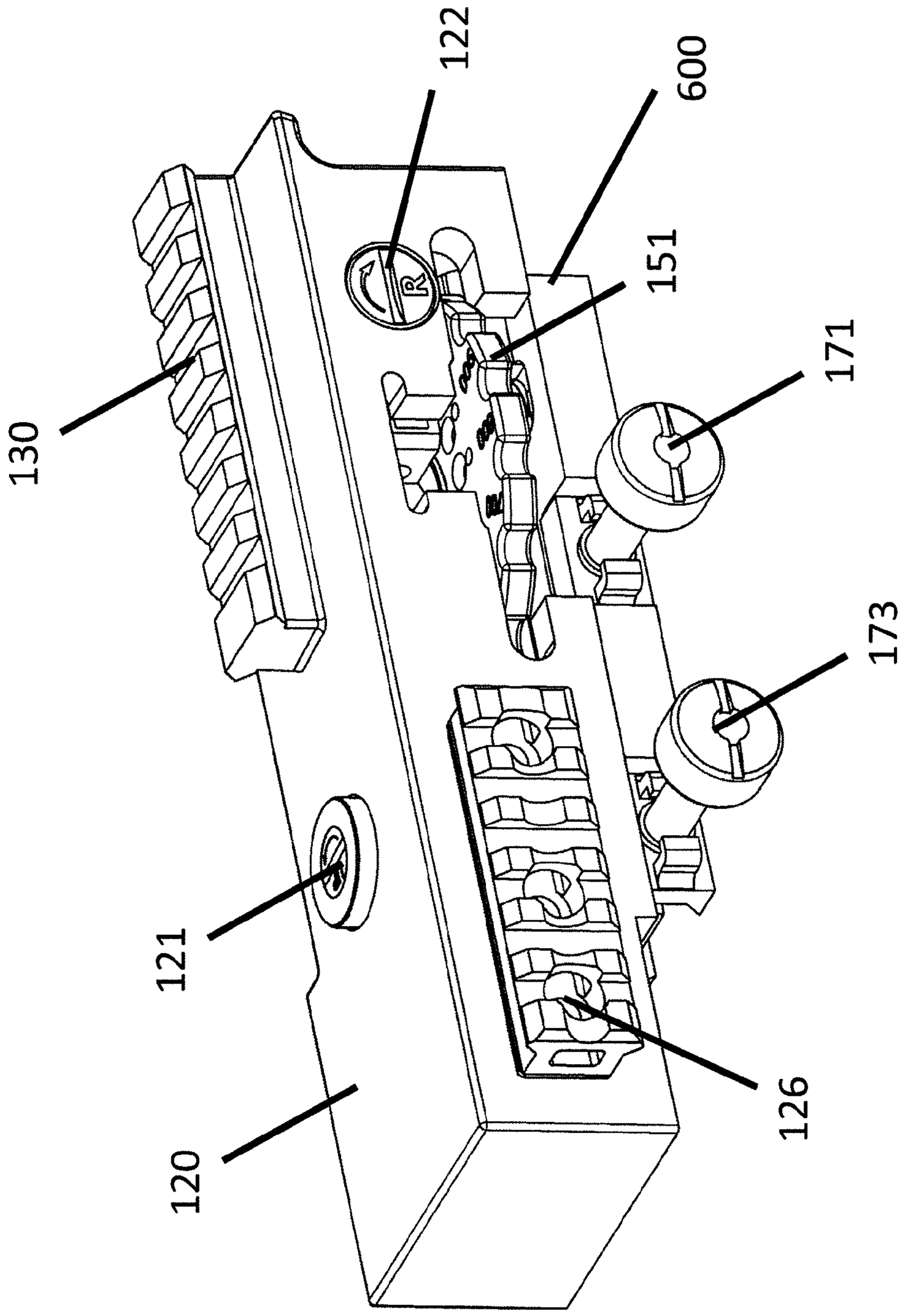


FIG. 3

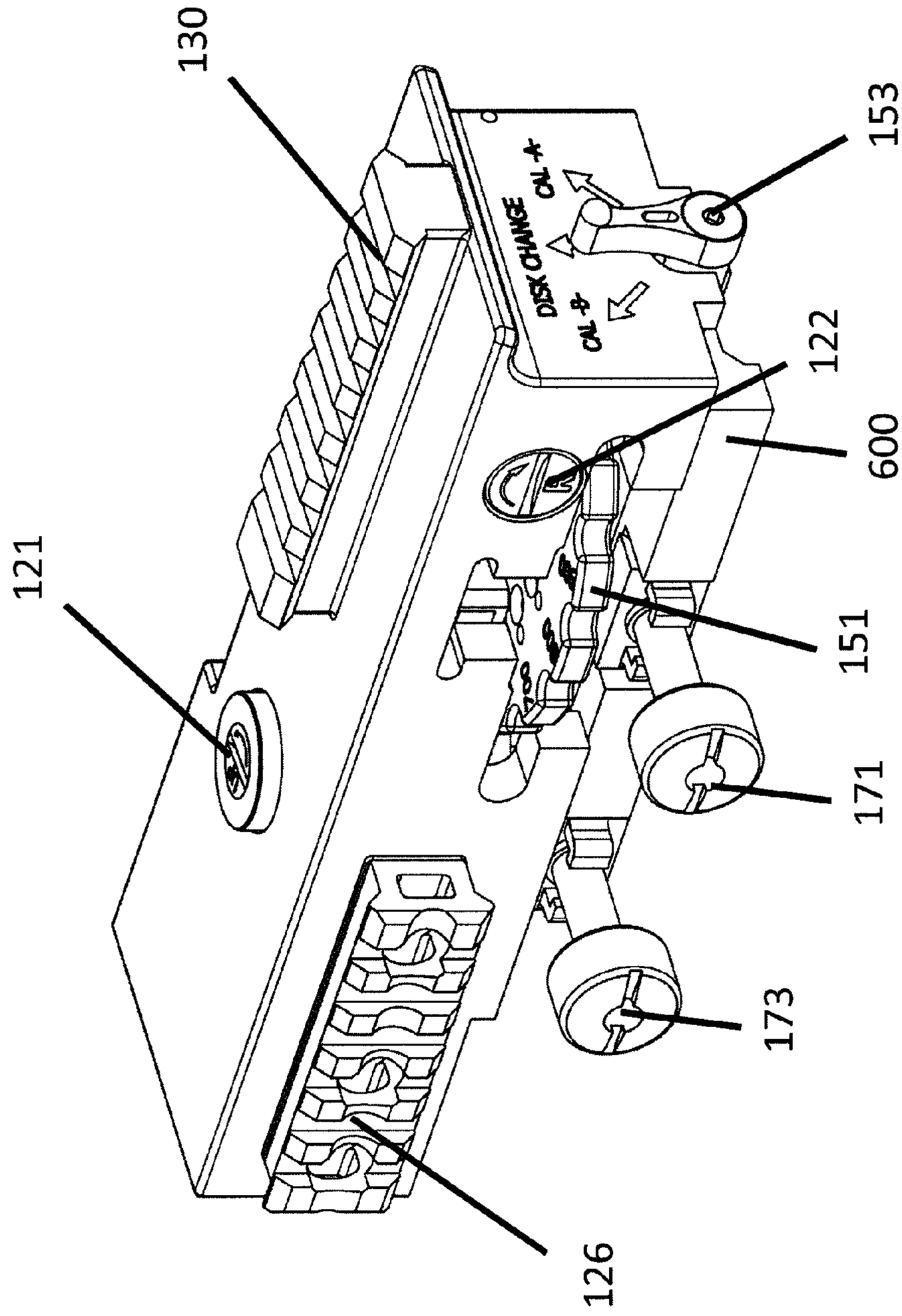


FIG. 4

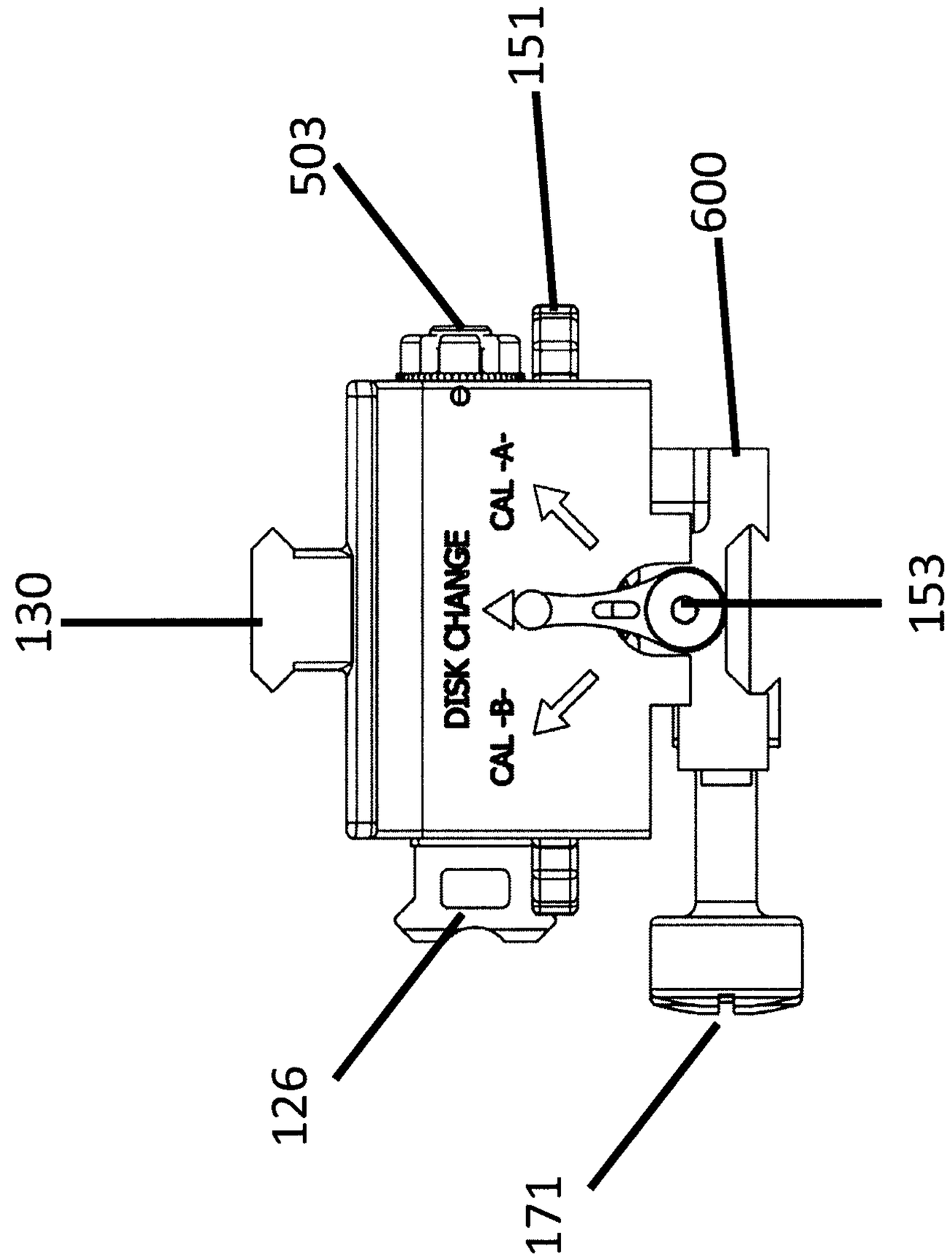


FIG. 5

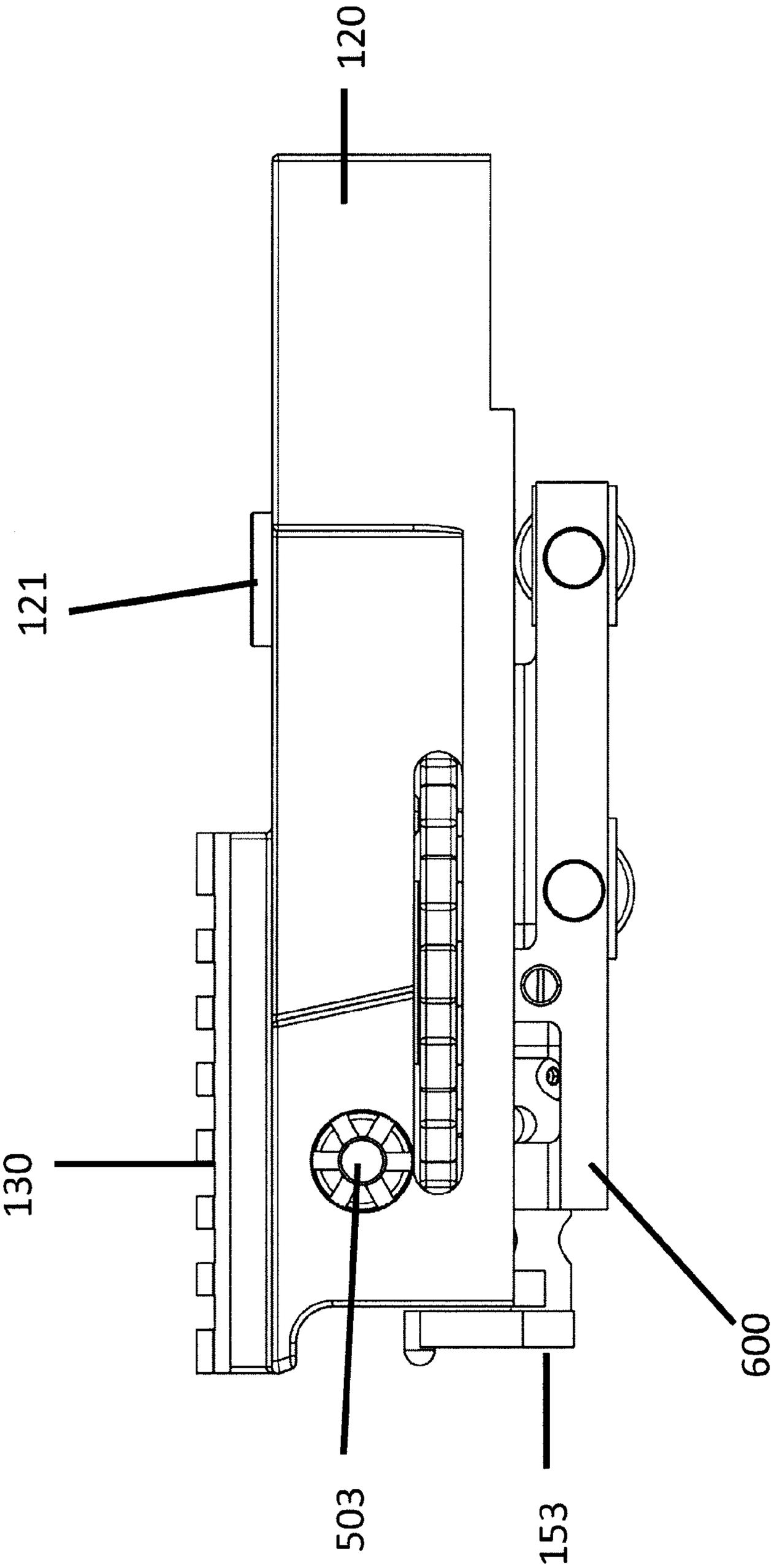


FIG. 6

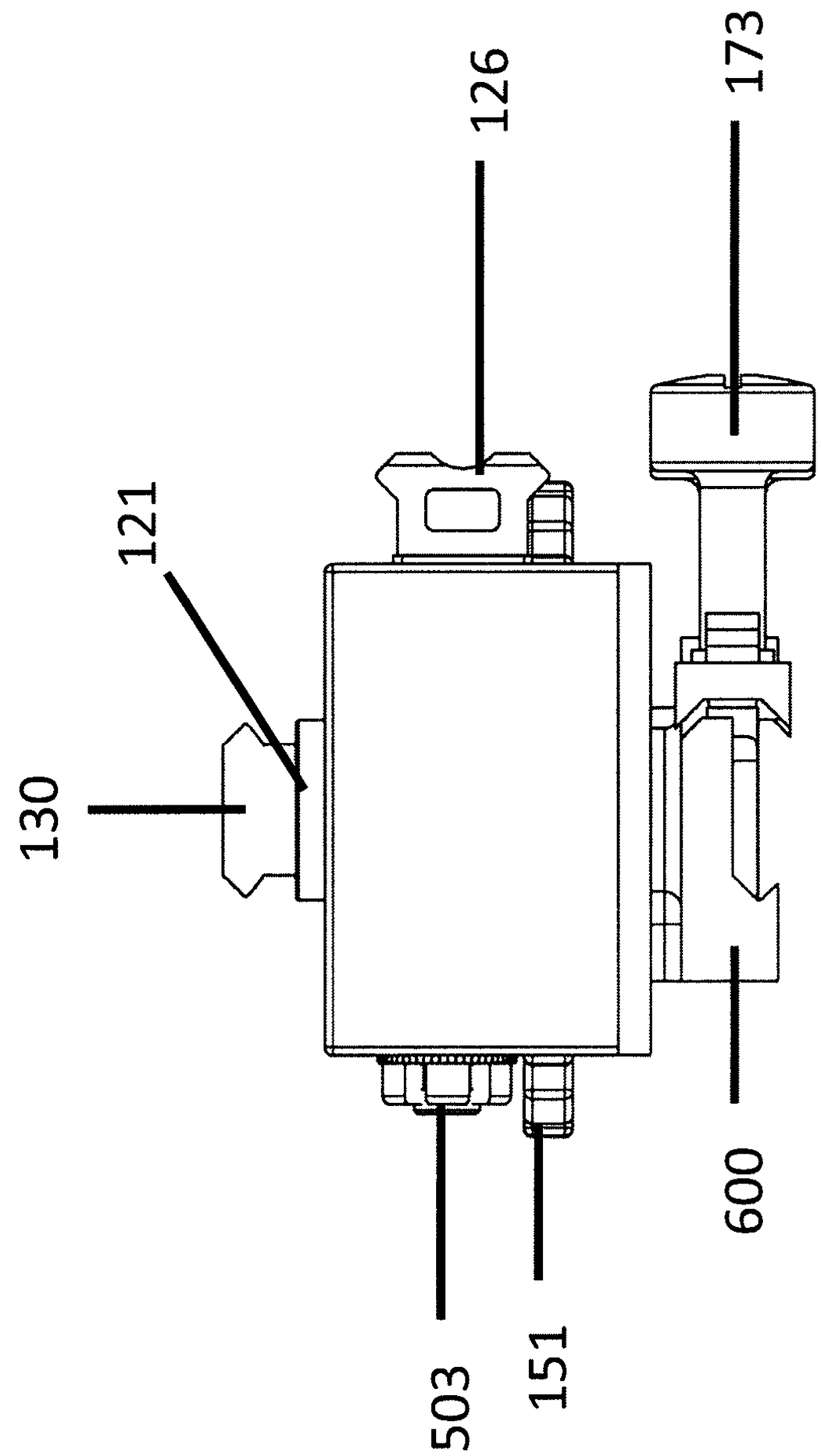


FIG. 7

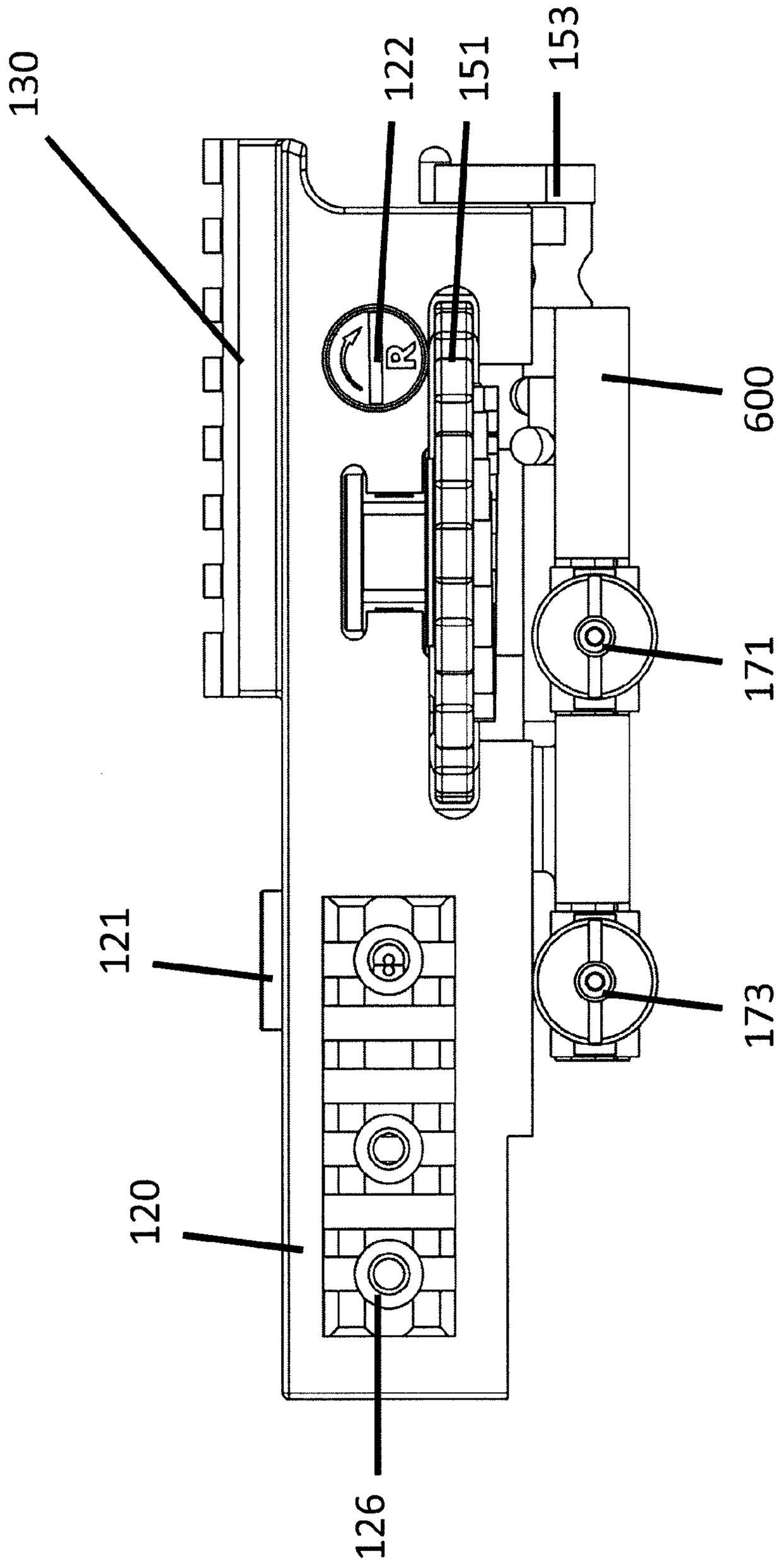


FIG. 8

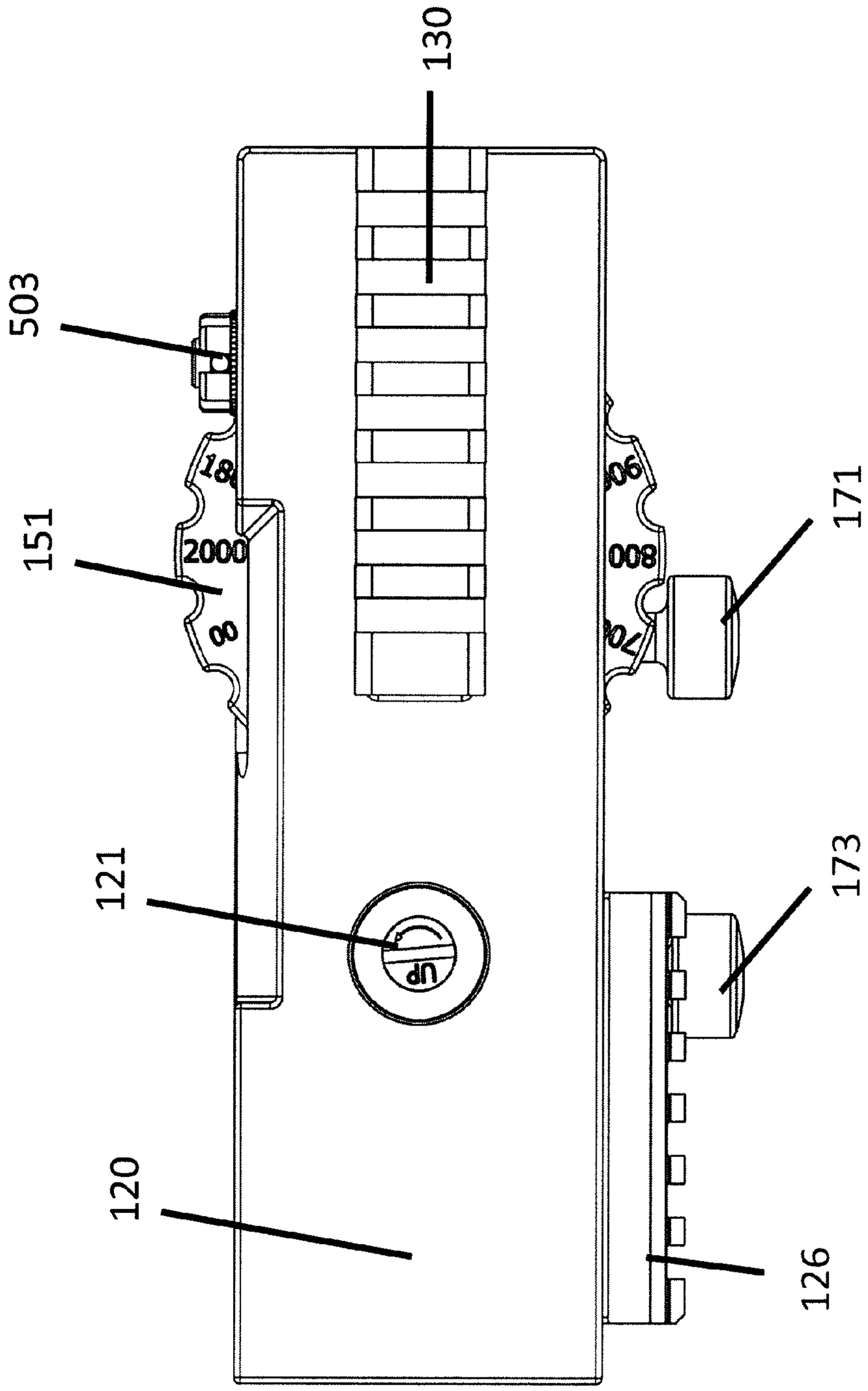


FIG. 9

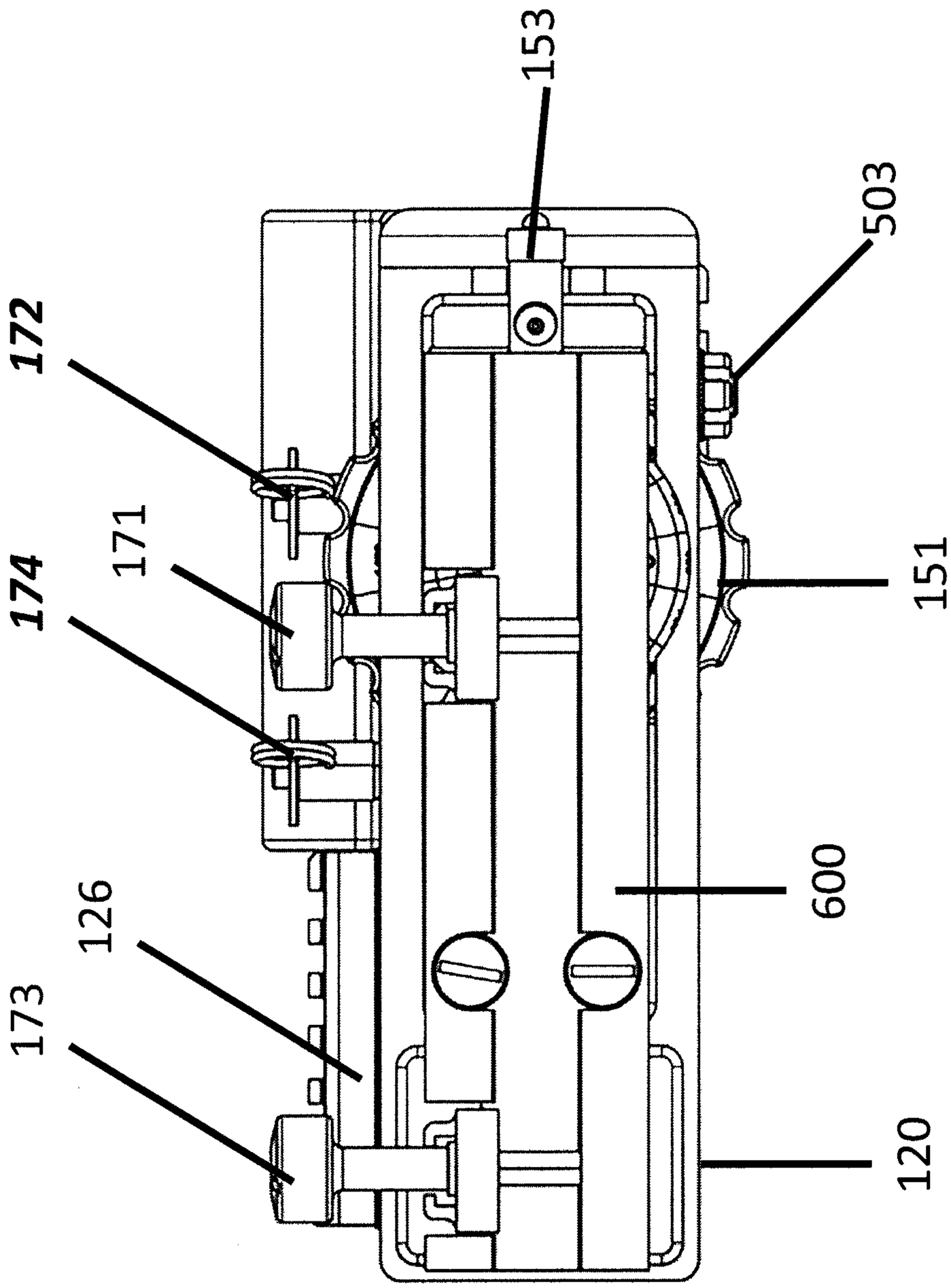


FIG. 10

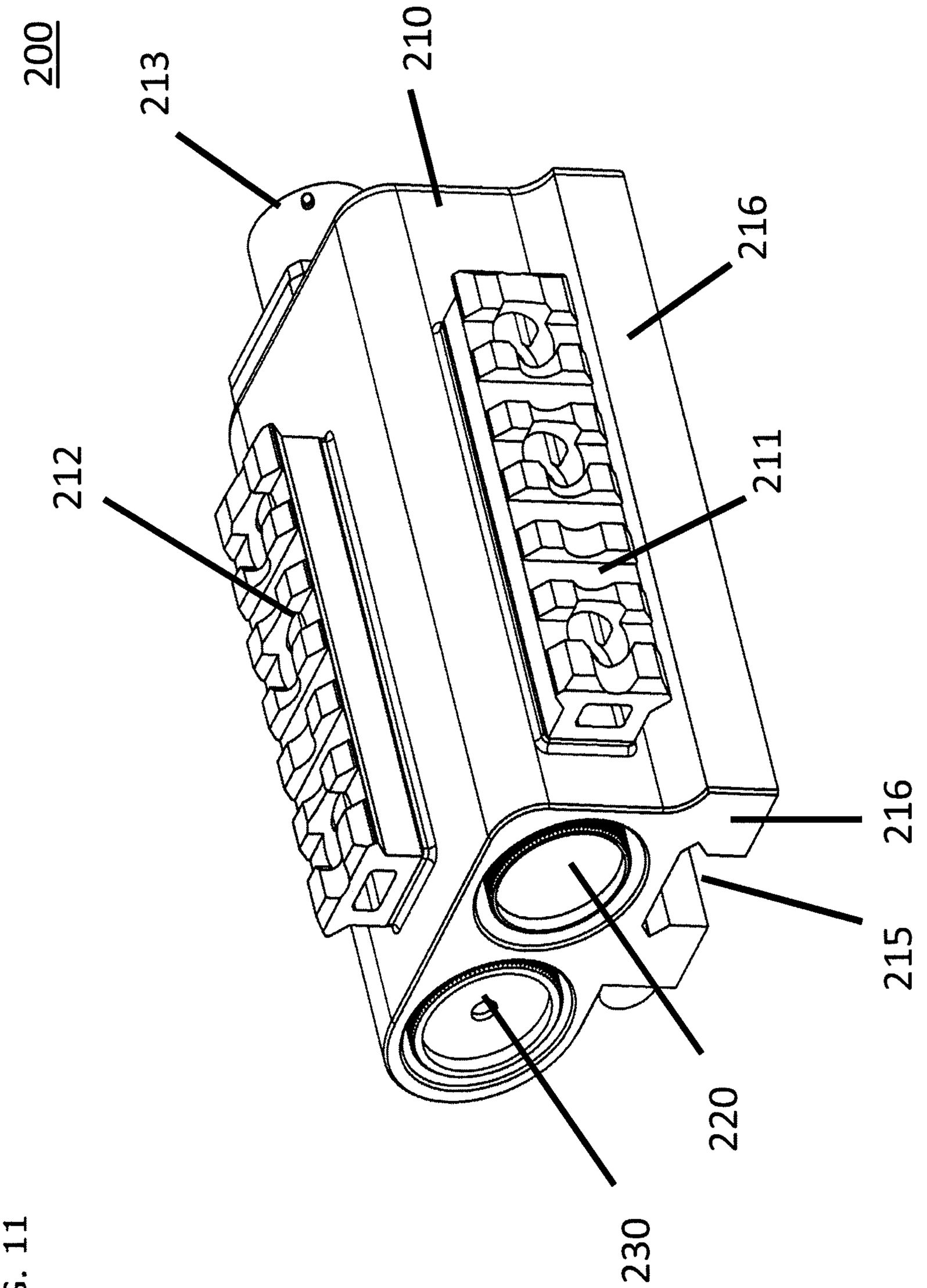


FIG. 11

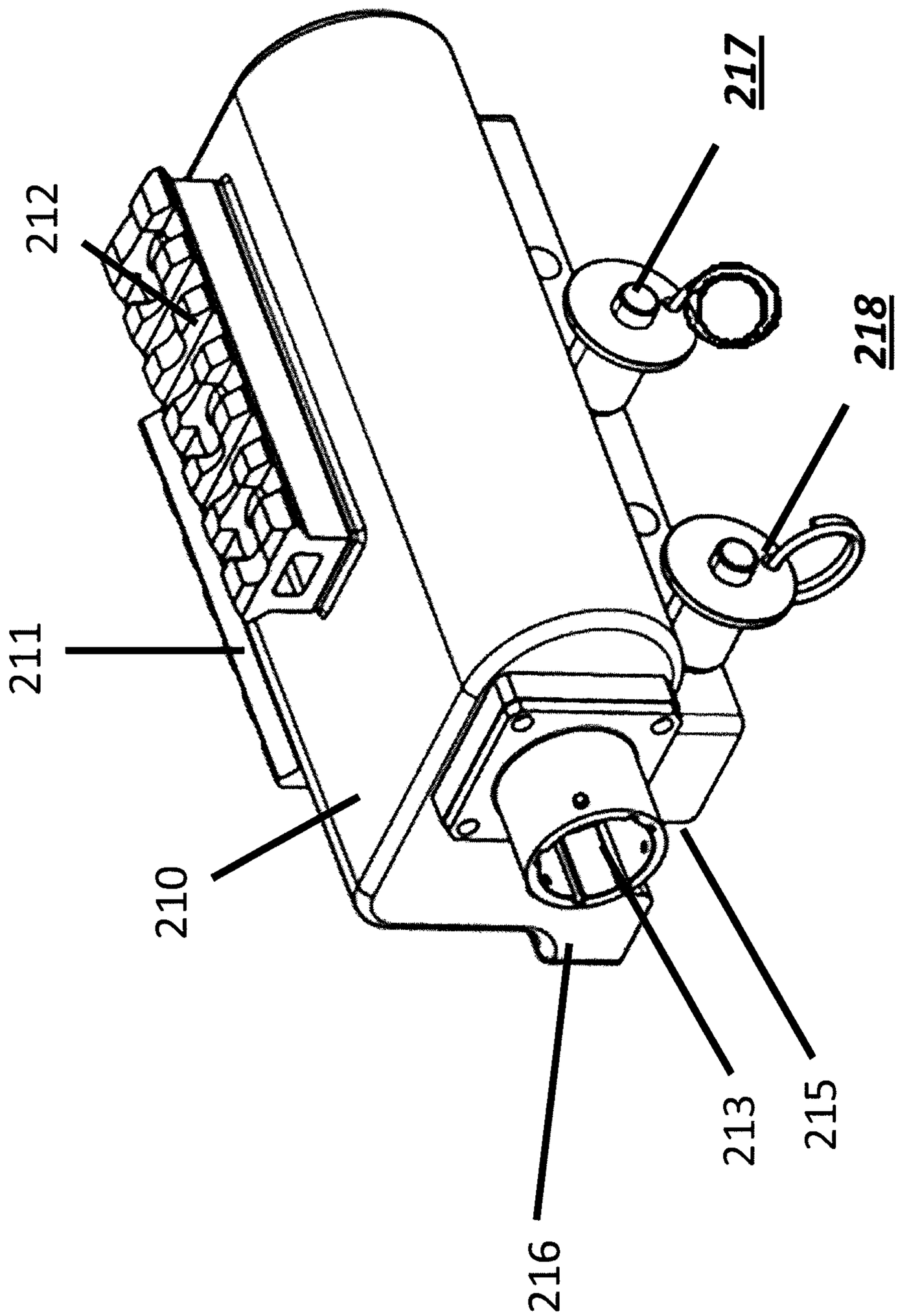


FIG. 12

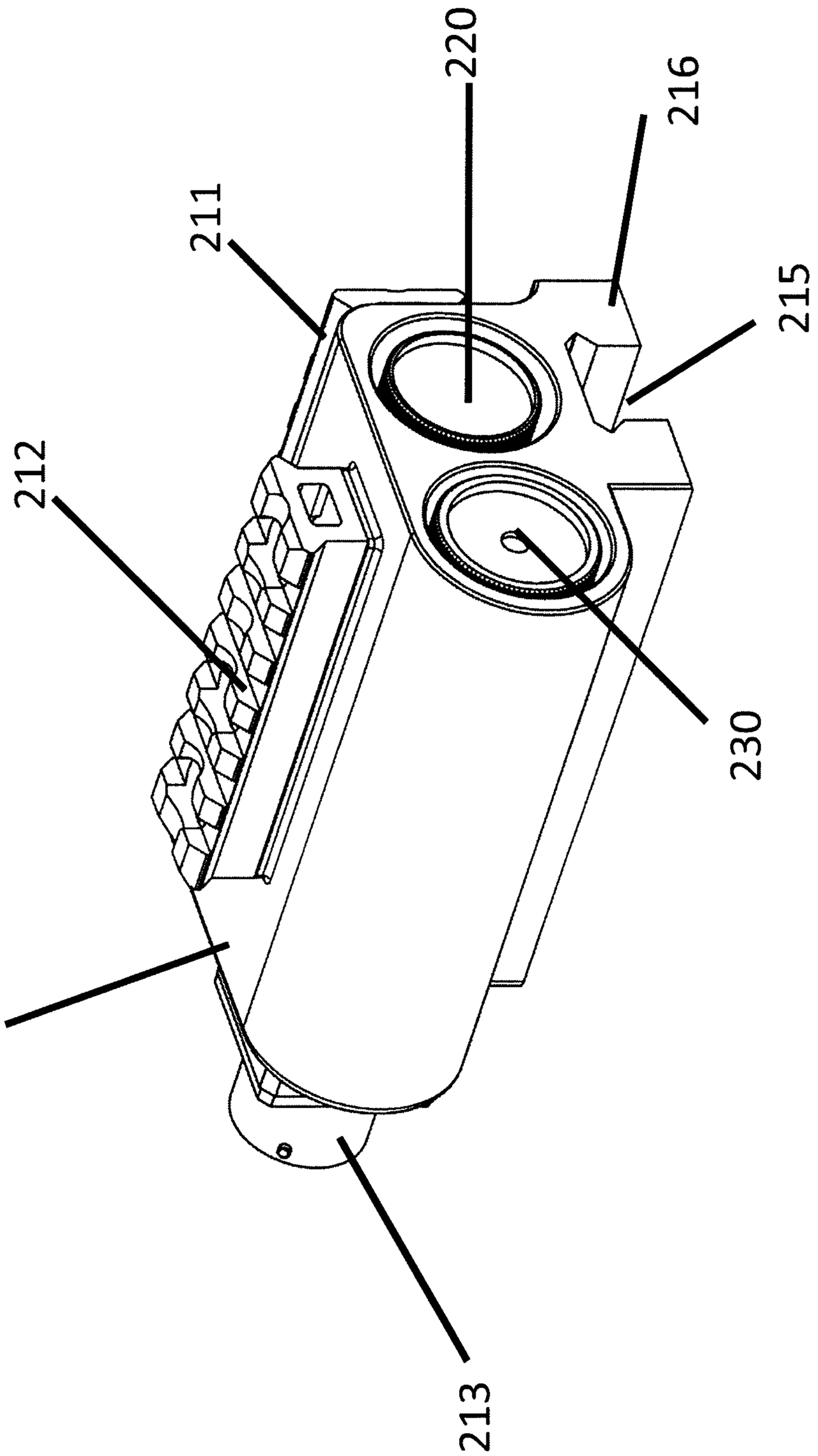


FIG. 13

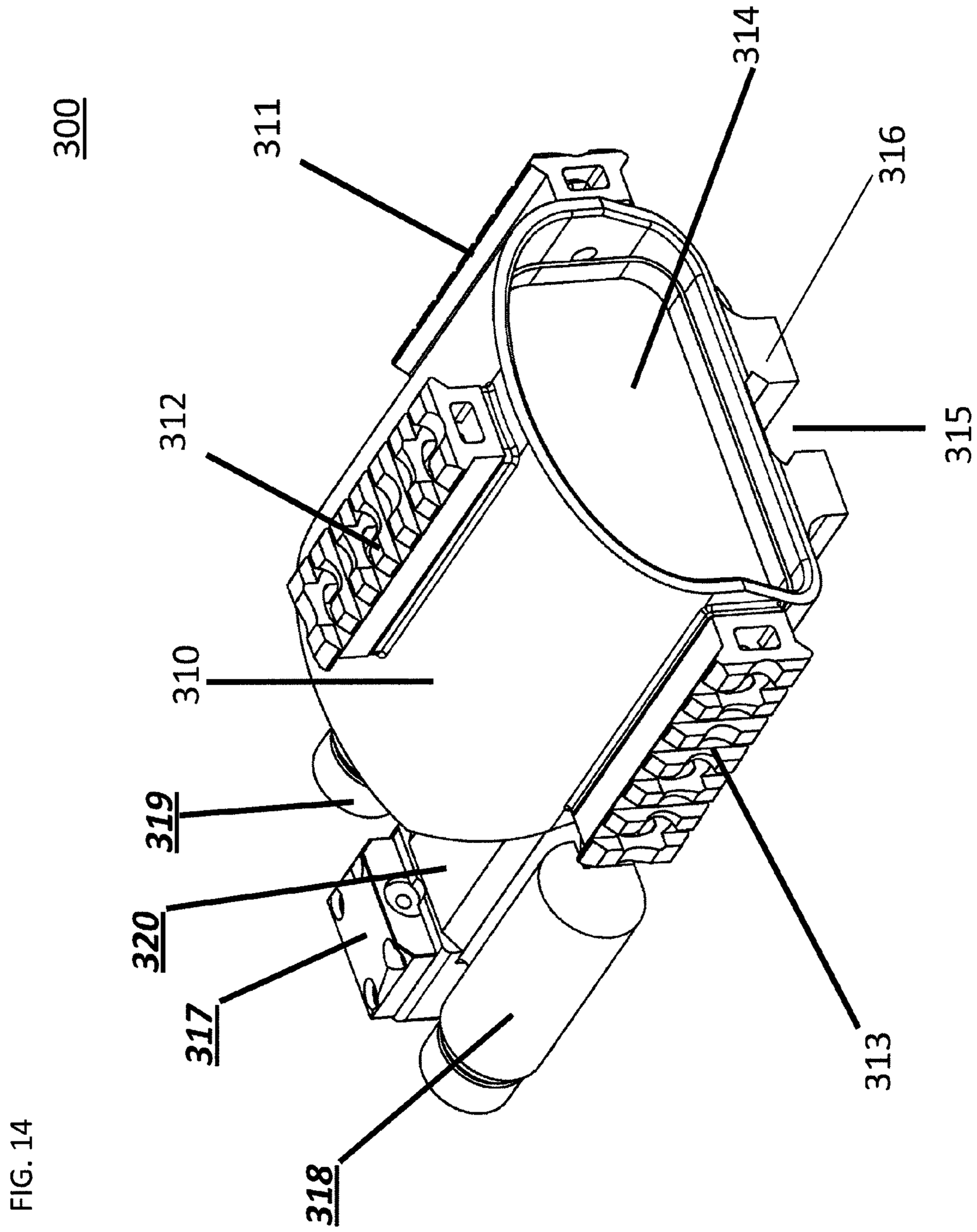


FIG. 14

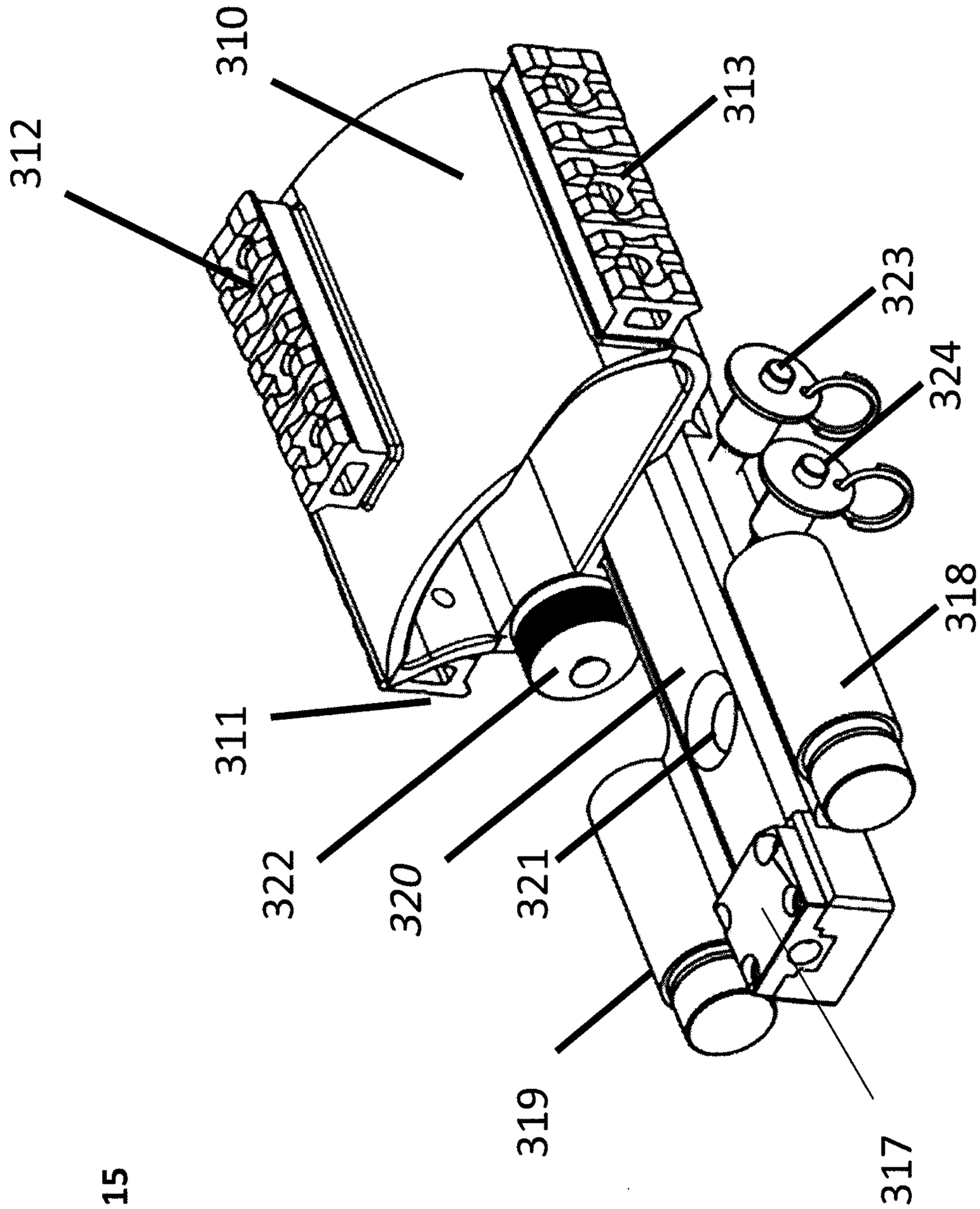


FIG 15

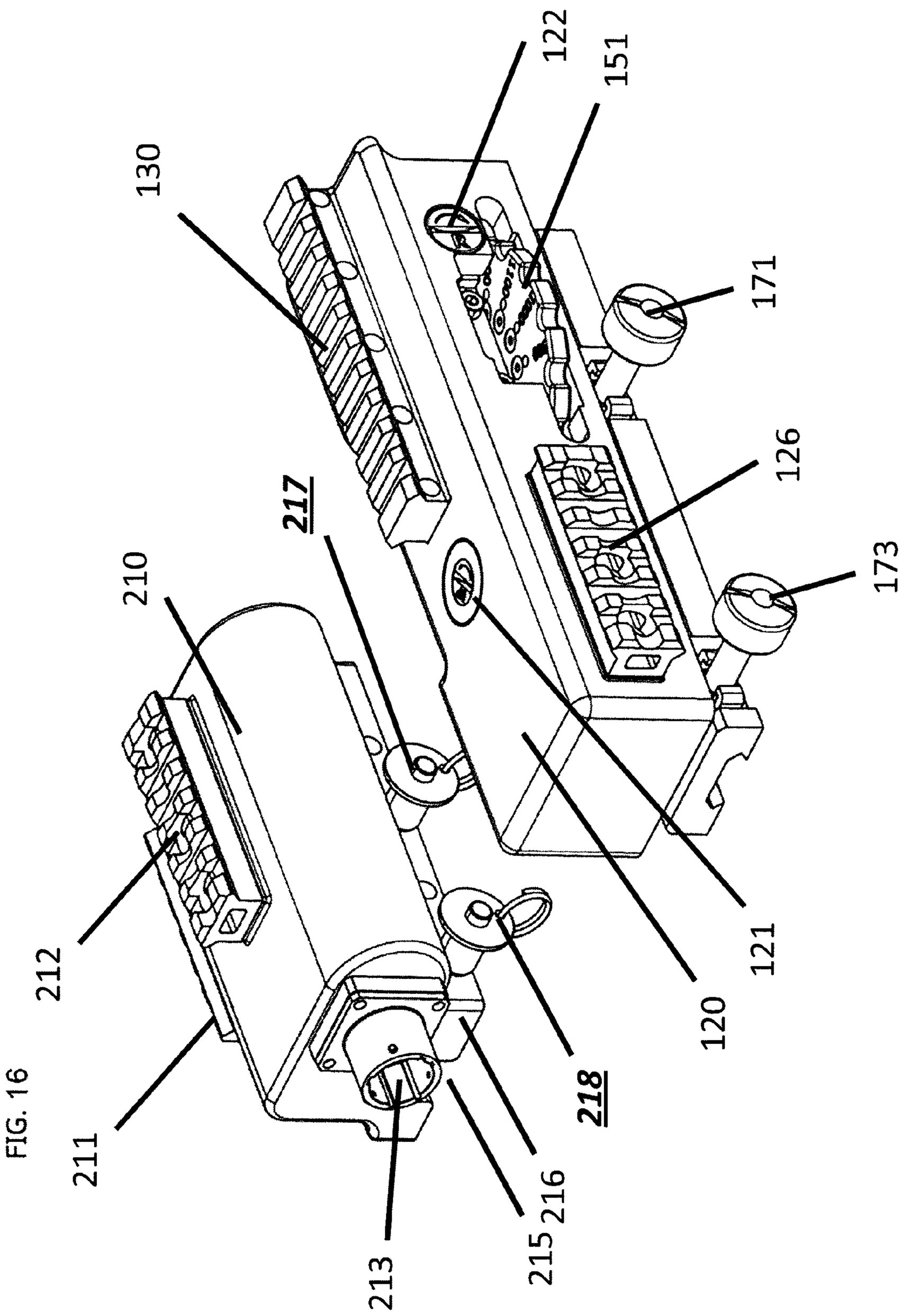


FIG. 16

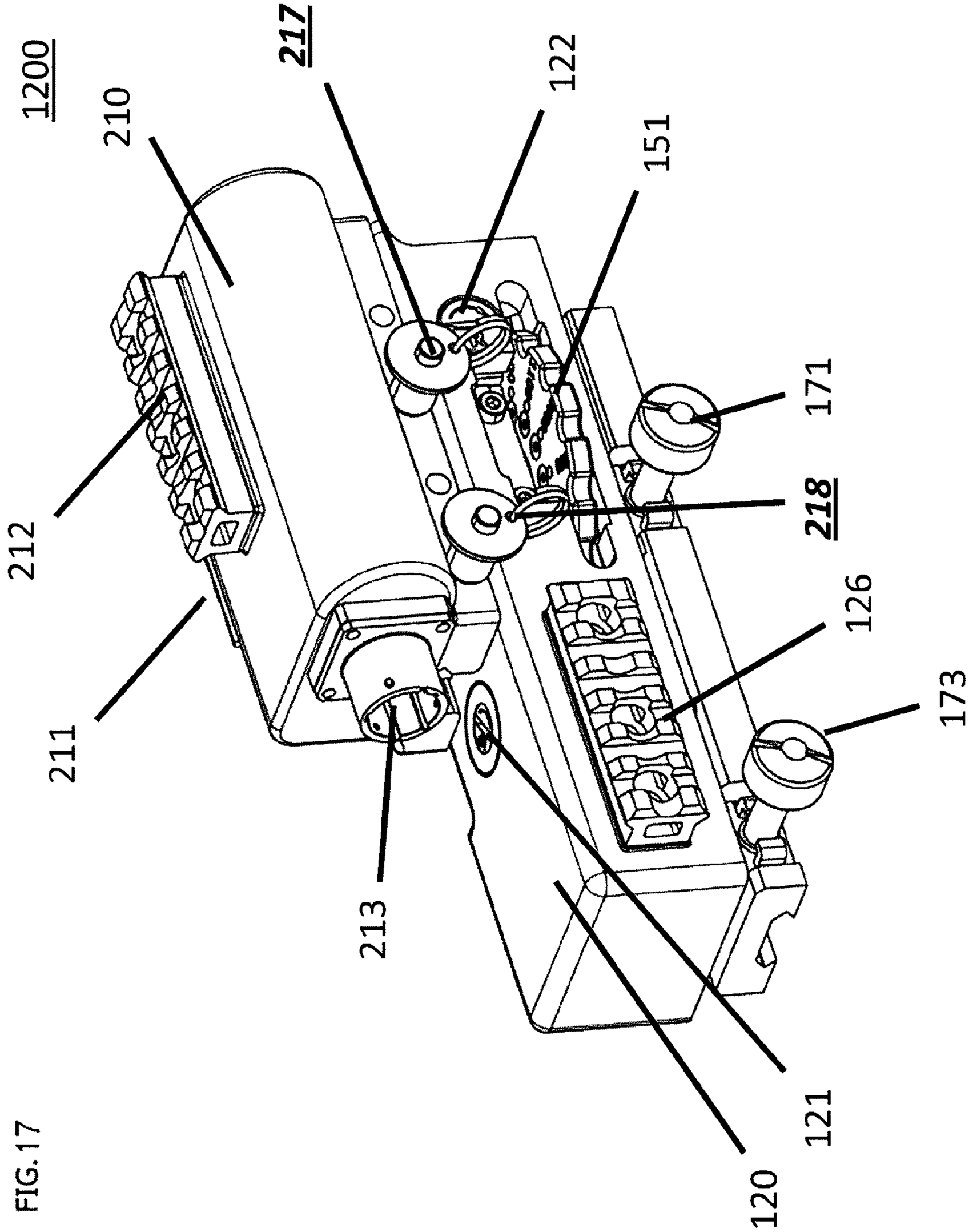
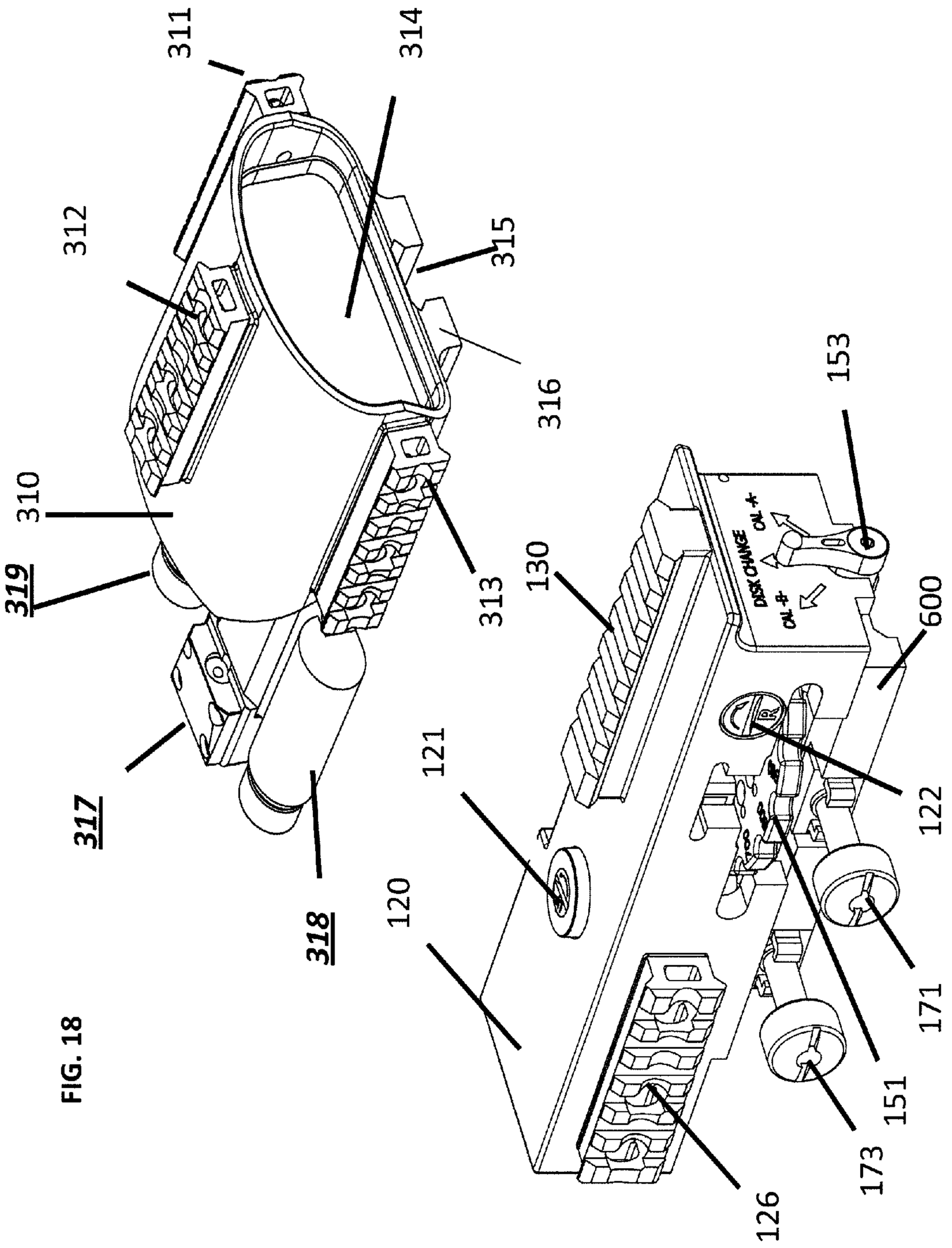


FIG.17


311
314
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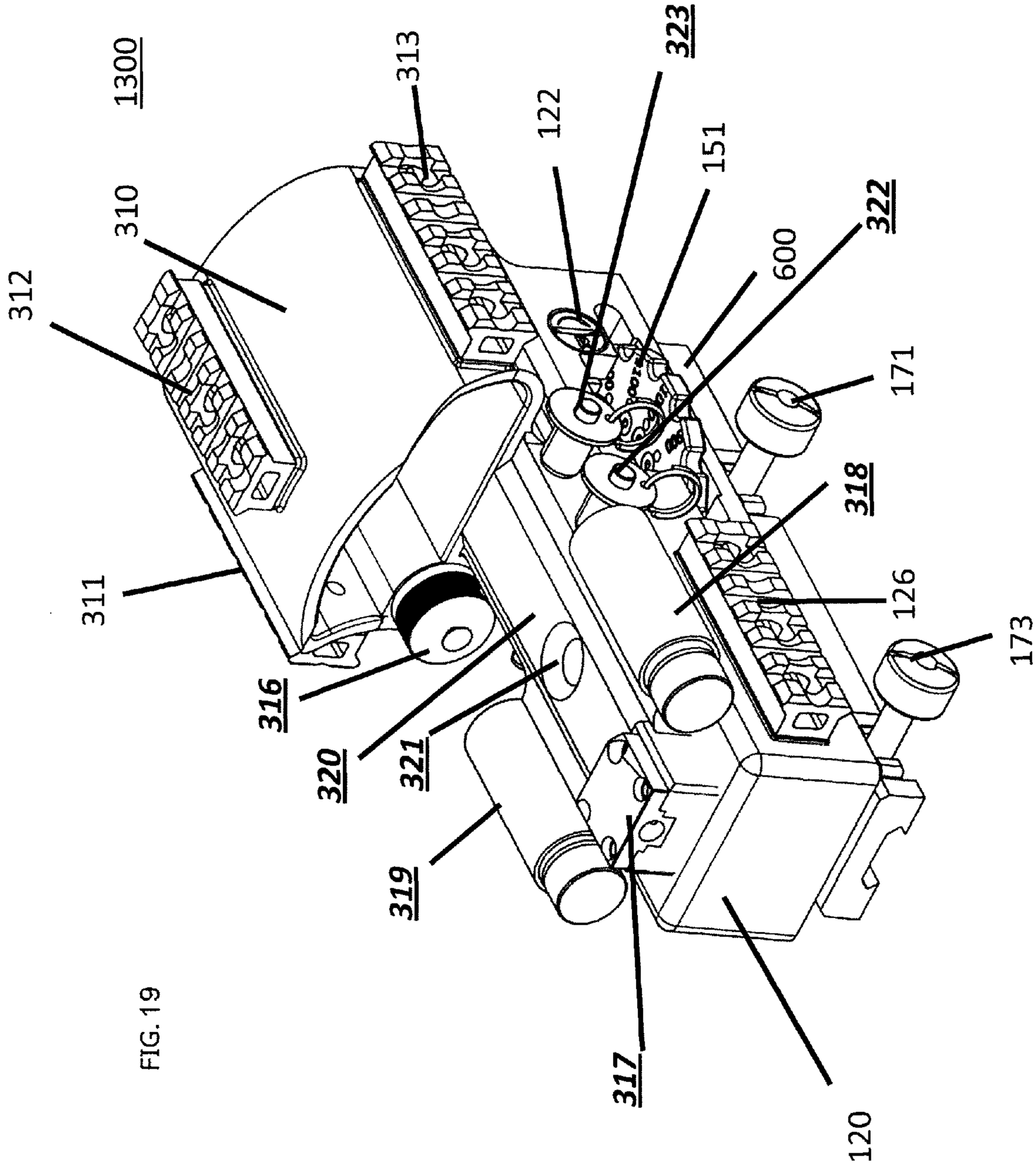
121
120
318
153
600
122
171
151
173
126

FIG. 18


1300
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122
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120

FIG. 19

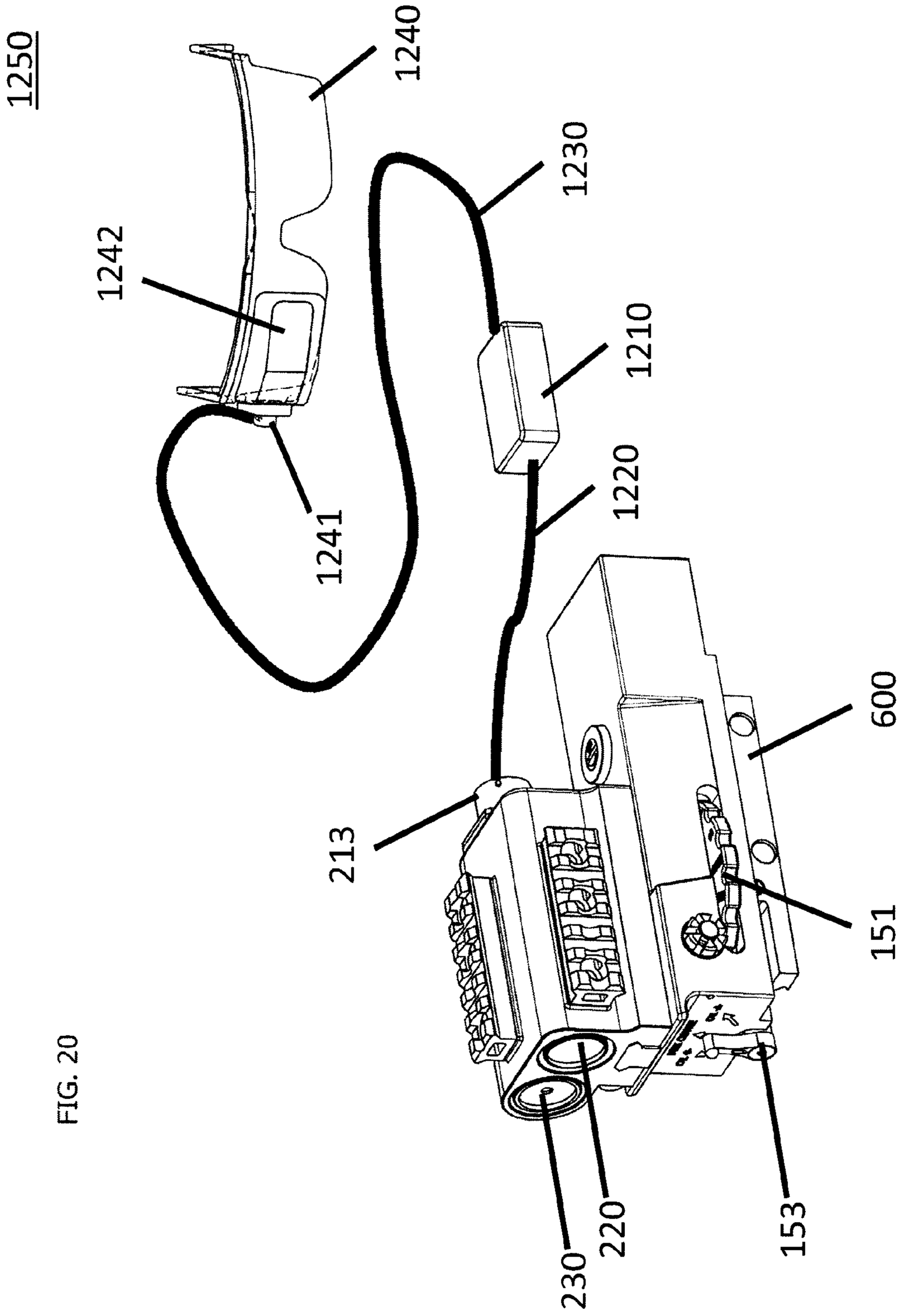

FIG. 20

DIGITAL MACHINEGUN OPTIC WITH BULLET DROP COMPENSATION MOUNT

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a divisional of co-pending U.S. application Ser. No. 13/436,366 filed on Mar. 30, 2012, which in turn claims the benefit of U.S. provisional application No. 61/565,387 filed on Nov. 30, 2011, and also is a continuation-in-part of co-pending U.S. application Ser. No. 13/304,082 filed on Nov. 23, 2011, which in turn is a continuation-in-part of co-pending U.S. application Ser. No. 13/179,154 filed on Jul. 8, 2011. The disclosures of all these applications are incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

Embodiments of the invention relate to a sight device that is designed and built for firearms, especially heavy and medium size machine guns, for the purpose of all armed forces, hunters, and police departments. A sight device offers a very large field of view design that provides rapid target acquisition for both stationary and moving targets. In addition, a sighting device also provides pin-point accuracy, which ensures every round is on target to ultimately suppress enemies faster, reduce collateral damage, and conserve ammunition. To provide such pin-point accuracy, a digital machinegun optic (DMO) comes with a bullet drop compensation mount (BDCM), which allows shooters to install the mount easily and quickly to any firearms, such as medium and heavy machineguns. The digital machinegun optic (DMO) can be easily and quickly converted into a universal machinegun optic (a red dot sight) and/or an all weather machinegun optic (a thermal sight) due to its modular design.

2. Discussion of the Related Art

Iron sights are commonly used by shooters for aiming firearms such as rifles, or medium and heavy machine guns. Each iron sight requires the shooter to align a rear and front sights of a rifle along with the target, which requires trainings and shooting skills.

Dot sights were developed for the purpose of offering rapid target acquisition of both stationary and moving targets with limited training. A sight can easily convert non-experienced shooter into a skilled marksman. A sight is also commonly known as a non-magnifying reflector (or reflex) sight that is mounted on firearms to provide the shooter an aiming indication in the form of a red dot or a red dot with a circle. Sights are designed and developed to offer shooters, such as sportsmen, hunters, policemen and soldiers the ability to acquire and engage target or targets quickly and effectively. Sights are user friendly devices in the sense that it only requires the shooter to aim the red dot on the target and upon pulling the trigger, a projectile will impact the point of aim.

A dot sight comes with a red light-emitting diode (LED) at the focus of the collimating optics to generate a light that is visible to the human eye. A visible dot remains parallel to a bore of the firearm no matter what position the human eye is in relative to the dot sight.

A dot sight can also use an infrared light source at the focus of the collimating optics to generate a light that is invisible to the human eye. By using an IR coating technology, an illuminated reticle will then be visible at the lens that stays in alignment with the weapon. The dot sight then may be attached to the weapon regardless of eye position (i.e., parallax free).

A very large field of view design enables the shooter to keep both eyes open during operation to enable an unlimited field of view at any distance. The eye relief is also unlimited, which means that the shooter's eye position behind the sight does not affect how well the shooter sees the target.

Shooting with both eyes open offers the shooter enhanced situational awareness to allow the possibility to deal with multiple targets. A dot sight helps a shooter become an effective marksman offering ability to aim accurately and quickly under any extreme or stressful conditions.

SUMMARY OF THE INVENTION

An object of an embodiment of the invention is to provide an aiming device that offers the shooter capabilities to engage single or multiple targets as quickly as possible while delivering accuracy in a user-friendly device.

Another object of an embodiment of the invention is to provide a bullet drop compensation mount to be used with various firearms, such as various medium and large size machineguns.

Another object of an embodiment of the invention is to provide shooters options to install any commonly available aiming devices such as a dot sight device, a day and night camera, an illuminator, and a thermal camera on top of the bullet drop compensation mount in order to allow the shooters to engage a target or targets effectively and accurately using a dual bullet drop compensation wheel. Upon confirmation of a distance to a target of interest, a shooter can engage it with pin-point accuracy just by rotating the dual bullet drop compensation wheel that allows a selection of a distance, for example, from 100 m to 2000 m.

Another object of an embodiment of the invention is to easily convert the bullet drop compensation mount into a digital machinegun optic (DMO) by installing a digital module. The digital module includes a rugged camera and an infrared (IR) illuminator. The camera is a device that obtains image data from an object by converting light from the object into the image data by using an image capturing sensor, such as a charge-coupled device (CCD) and an active pixel sensor. The camera may have a reticle to help the shooters to engage targets quickly and accurately. The IR illuminator may automatically activate to provide visibility during a night operation. A plurality of rails may be installed to the DMO in order to install other devices such as laser pointers, dazzler lasers, flash lights, laser range finders, night vision devices, and thermal cameras thereto.

Another object of an embodiment of the invention is to provide a DMO that may be used to aim at targets during any day and night operations.

Another object of an embodiment of the invention is to provide the DMO that may be used with various caliber arms. The DMO can be used with multiple firearms as it comes with multiple ballistic drop compensation wheels (5.56 mm and 7.62 mm, 7.62 mm and 12.7 mm, and 12.7 mm and 20 mm). One DMO may be used with multiple firearms with different ballistics.

Another object of an embodiment of the invention is to provide a DMO that can receive target distance information (100 m-2000 m) and easily control a bullet drop compensation wheel for quick, easy, and accurate target acquisition.

Another object of an embodiment of the invention is to provide a bullet drop compensation mount that is designed to allow easy and quick installation to firearms, such as medium and heavy machineguns without a special tool or wrench, since tools used to install sights are usually lost during training and deployments.

Another object of an embodiment of the invention is to easily convert the bullet drop compensation mount into a universal machinegun optic (UMO) by installing an optical module or a red dot sight. A plurality of rails may be installed on the universal machinegun optic (UMO) in order to install other devices such as laser pointers, dazzler lasers, flash lights, laser range finders, night vision devices, and thermal cameras thereto.

Another object of an embodiment of the invention is to provide a universal machinegun optic (UMO) having capability to engage and aim at targets during any day and night operations.

Another object of an embodiment of the invention is to provide a dot sight device that is able to automatically control a brightness of a targeting dot.

Another object of an embodiment of the invention is to easily convert the bullet drop compensation mount into an all weather machinegun optic (AWMO) by installing any commonly available thermal camera module. A plurality of rails may be installed to the thermal camera module that allows the installation of other devices such as laser pointers, dazzler lasers, flash lights, laser range finders, and night vision devices thereto.

Another object of an embodiment of the invention is to provide an all weather aiming device that may be used to aim at targets during any weather operations.

Additional features and advantages of this invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of this invention. The objectives and other advantages of this invention will be realized and attained by the structure particularly pointed out in the written description and claims thereof as well as the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention. In the drawings:

FIG. **1** shows a perspective view of a left front side of a bullet drop compensation mount (BDCM) according to an example embodiment of the invention;

FIG. **2** shows a perspective view of a left back side of the bullet drop compensation mount according to an example embodiment of the invention;

FIG. **3** shows a perspective view of a right back side of the bullet drop compensation mount according to an example embodiment of the invention;

FIG. **4** shows a perspective view of a right front side of the bullet drop compensation mount according to an example embodiment of the invention;

FIG. **5** shows a front elevational view of the bullet drop compensation mount according to an example embodiment of the invention;

FIG. **6** shows a left side elevational view of the bullet drop compensation mount according to an example embodiment of the invention;

FIG. **7** shows a back elevational view of the bullet drop compensation mount according to an example embodiment of the invention;

FIG. **8** shows a right side elevational view of the bullet drop compensation mount according to an example embodiment of the invention;

FIG. **9** shows a top plan view of the bullet drop compensation mount according to an example embodiment of the invention;

FIG. **10** shows a bottom plan view of the bullet drop compensation mount according to an example embodiment of the invention;

FIG. **11** shows a perspective view of a left front side of a digital module according to an example embodiment of the invention;

FIG. **12** shows a perspective view of a right back side of the digital module according to an example embodiment of the invention;

FIG. **13** shows a perspective view of a right front side of the digital module according to an example embodiment of the invention;

FIG. **14** shows a perspective view of a right front side of an optical module according to an example embodiment of the invention;

FIG. **15** shows a perspective view of a right back side of the optical module according to an example embodiment of the invention;

FIG. **16** shows a perspective view of a right back side of the bullet drop compensation mount and the digital module prior to attachment according to an example embodiment of the invention;

FIG. **17** shows a perspective view of a right back side of the bullet drop compensation mount and the digital module after attachment according to an example embodiment of the invention;

FIG. **18** shows a perspective view of a right front side of the bullet drop compensation mount and the optical module prior to attachment according to an example embodiment of the invention;

FIG. **19** shows a perspective view of a right back side of the bullet drop compensation mount and the optical module after attachment according to an example embodiment of the invention; and

FIG. **20** shows a digital machinegun optic (DMO) attached to a control box and a head mounted display according to an example embodiment of the invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Hereinafter, example embodiments of this invention will be described in detail with reference to FIGS. **1-20**. Like reference numerals designate like elements throughout the specification.

FIGS. **1-10** shows various views of a bullet drop compensation mount according to an example embodiment of the invention, whereby FIG. **1** shows a perspective view of a left front side of a bullet drop compensation mount according to an example embodiment of the invention; FIG. **2** shows a perspective view of a left back side of the bullet drop compensation mount according to an example embodiment of the invention; FIG. **3** shows a perspective view of a right back side of the bullet drop compensation mount according to an example embodiment of the invention; FIG. **4** shows a perspective view of a right front side of the bullet drop compensation mount according to an example embodiment of the invention; FIG. **5** shows a front elevational view of the bullet drop compensation mount according to an example embodiment of the invention; FIG. **6** shows a left side elevational view of the bullet drop compensation mount according to an example embodiment of the invention; FIG. **7** shows a back elevational view of the bullet drop compensation mount according to an example embodiment of the invention; FIG. **8**

shows a right side elevational view of the bullet drop compensation mount according to an example embodiment of the invention; FIG. **9** shows a top plan view of the bullet drop compensation mount according to an example embodiment of the invention; and FIG. **10** shows a bottom plan view of the bullet drop compensation mount according to an example embodiment of the invention.

A bullet drop compensation mount **100** includes a body **120**, a mounting solution **600** connected to the body **120**, an elevation control knob **121** supported by the body **120**, an attachment rail **130**, a dual bullet drop compensation wheel **151**, a caliber adjustment knob **153**, and a windage knob stopper/PIN **503**. The body **120** also supports a windage knob **122**, and an optional side rail **126**. In turn, the mounting solution **600** includes a first bolt **171** and a second bolt **173** attached thereto.

As shown in FIGS. **1** and **2**, the body **120** is a multiple piece construction that includes various elements. The body **120** supports the dual bullet drop compensation wheel **151** within it in a manner that exposes radial edge portions of the dual bullet drop compensation wheel **151** at opposing side portions of the body **120**. Located along a top surface of the body **120** is the attachment rail **130** that is designed to receive a digital module, an optical module, or an all weather machinegun optic (a thermal sight). The attachment rail **130** may receive other modules.

The body **120** supports the elevation control knob **121** at a position that is located behind the attachment rail **130**. Accordingly, the elevation control knob **121**, and the attachment rail **130** may be collinear. Further, the elevation control knob **121** may be disposed to be flush with the top surface of the body **120**.

The body **120** supports the optional side rail **126**, which is located on the back right side of the body **120**.

As shown in FIGS. **3** and **4**, the first bolt **171** and the second bolt **173** serve as knobs to mount the bullet drop compensation mount **100** (including any attached digital **200** or optical module **300**) to a firearm by using an attachment device, such as a picatinny rail, that is attached to the firearm. In particular, the mounting solution **600** that is included in the bullet drop compensation mount **100** is directly attached to the firearm or to the attachment device thereof. With the body **120** supporting the mounting solution **600**, the first bolt **171** and the second bolt **173** are used in attaching the bullet drop compensation mount **100** to various caliber firearms. The bolts **171** and **173** eliminate the need for wrenches that can be misplaced or lost.

Further, a windage knob **122** is located on a right side of the body **120**, above the dual bullet drop compensation wheel **151**, and is above the first bolt **171** and the second bolt **173**. On an opposite side of the body **120** from the windage knob **122** is the windage knob stopper/PIN **503** that is located above the dual bullet drop compensation wheel **151**.

In embodiments of the invention, the dual bullet drop compensation wheel **151** is in a form of a wheel that can be turned clock-wise or counter clock-wise for proper bullet drop compensation over distances. The dual bullet drop compensation wheel **151** is disposed parallel to the body **120**, and is generally disposed horizontally along a length of the bullet drop compensation mount **100**. In embodiments of the invention, the dual bullet drop compensation wheel **151** is used to adjust for the proper bullet drop compensation over distances.

In embodiments of the invention, use of the calibration adjustment knob **153** enables a user to select a desired caliber setting (e.g., 7.62 mm or 12.7 mm) without using any tools by, for example, being flipped from one side to another. Also, the bullet drop compensation mount **100** may include additional bullet drop compensation wheels to accommodate other dual caliber combinations, such as 5.56 mm/7.62 mm, 12.7 mm/20 mm and others.

In embodiments of the invention, the additional bullet drop compensation wheel **151** can be easily installed into a slot holding the calibration adjustment knob **153** for use with other caliber arms (i.e., 5.56 mm/7.62 mm and 12.7 mm/20 mm caliber arms, for example). By using the calibration adjustment knob **153** that can select between 7.62 mm or 12.7 mm caliber arms, the dual bullet drop compensation wheel **151** may be used to compensate drop of a bullet in 100 m increments—200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400, 1600, 1800 and 2000 in the case of the 7.62 mm caliber arms (with an effective range=800 m, and a Max=1200 m), for example. In the case of the 12.77 mm caliber arms compensation may be used for 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400, 1600, 1800, and 2000 (with an effective range=1800 m, and a Max=2000 m). For both caliber arms, the bullet drop compensation wheel **151** offers 16 setting (or compensations), but the number is not limited thereto. Any other settings may be used. The dual bullet drop compensation wheel **151** may have notches or protrusions that correspond to each of the increments or settings. The bullet drop compensation wheel **151** may compensate in increments other than 100 m.

In embodiments of the invention, one bullet drop compensation mount **100** may be used for all or a plurality of calibers just by changing a dual bullet drop compensation wheel **151**. Accordingly, the bullet drop compensation mount **100** may come with additional dual bullet drop compensation wheels **151** corresponding to a different set of calibers. In embodiments of the invention, each set of calibers may include two calibers. Accordingly, a first dual bullet drop compensation wheel corresponds to one set (a first set) of two calibers, and is exchangeable with another dual bullet drop compensation wheel that corresponds to another set (a second set) of two calibers. The first set of two calibers may be completely different from the second set of two calibers, or one of the two calibers from the first set may be the same as one of the two calibers from the second set.

The bullet drop compensation mount **100** with a dual bullet drop compensation wheel **151** is truly a universal medium and heavy machinegun mount, in which one mount may be used for all calibers just by replacing a dual bullet drop compensation wheel **151**.

In FIGS. **1-10**, the attachment rail **130** is depicted as a picatinny rail. Nevertheless, in various embodiments of the invention, a means of attaching the digital module **200** or the optical module **300** to the bullet drop compensation mount **100** need not be an attachment rail, such as a picatinny rail. Other devices to effect the attachment thereof may be used.

Hereinafter, a digital module **200** will be discussed. FIGS. **11-13** show various views of a digital module according to an example embodiment of the invention, whereby FIG. **11** shows a perspective view of a left front side of a digital module according to an example embodiment of the invention; FIG. **12** shows a perspective view of a right back side of the digital module according to an example embodiment of the invention; and FIG. **13** shows a perspective view of a right front side of the digital module according to an example embodiment of the invention.

The digital module **200** according to an example embodiment of the invention includes a body **210** supporting one or more rails **211** and **212**, a mil-connector **213**, a platform **216** containing a receiving groove **215**, a camera **220**, and an illuminator **230** emitting an infrared (IR) or laser light.

In greater detail, the body **210** supports a side rail **211** and a top rail **212**, but the number of rails **211** and **212** may vary, such as the number of attachments to be provided to the digital module **200**. In embodiments of the invention, an additional optional side rail may be included at an opposite side of the body **210** from the side rail **211**. In embodiments of the invention, the side rail **211** may support a dazzler laser, which may emit a non-lethal laser at an enemy to temporarily blind the enemy, for example. The camera **220** is will have a capability to detect an enemy pointing with a laser.

The mil-connector **213** is attached to a cable that provides power from a power pack to the camera **220** and the illuminator **230**, and also carries data signals from the camera **220** to an external display device and carries control signals from an external controller to the camera **220** and the illuminator **230**.

The platform **216** is formed integrally with the body **210**, and thereby supports the digital module **200**. The receiving groove **215** is formed so as to fit onto the attachment rail **130** of the bullet drop compensation mount **100** to secure placement of the digital module **200** onto the bullet drop compensation mount **100**. Two easily attachable/removable pins **217** and **218** are used to secure the digital module **200** into the bullet drop compensation mount **100**, but the number thereof need not be limited to two.

The camera **220** is a device that obtains image data from an object by converting light from the object into the image data by using an image capturing sensor, such as a charge-coupled device (CCD) and an active pixel sensor. The obtained image data may be processed in the camera **220**, or may be transmitted to the external controller and/or the external display device via the cable attached to the mil-connector **213**. The camera **220** may have a zoom function, which may be performed by a zoom lens system included in the camera **220** (i.e., optical zoom) or by processing the image data (i.e., digital zoom), or a combination thereof. In embodiments of the invention, various magnifications of optical zooms and digital zooms are usable, such as up to 10× optical zoom, and/or up to 4× digital zoom. Use of the zoom function permits users to positively identity enemy targets at a long distance.

In addition to providing image data, the camera **220** may provide a reticle used for targeting, which may be overlaid on the image data. The reticle may be a circle reticle having a dot and an enclosing circle, a mil-dot reticle having measurements or markings in an x and/or a y axis direction, or a target dot reticle with a single dot. Other reticles may be used. In embodiments of the invention, the circle reticle may be used for ground operations by, for example, infantry; the mil-dot reticle may be used for sea operations by, for example, on seacrafts; and the target dot reticle may be used for air operations by, for example, on aircrafts. In embodiments of the invention, the reticle need not be provided by the camera **220**, and instead, may be provided by the external display device or the external controller.

The illuminator **230** emits at least one of an infrared (IR) light or a laser light so that, for example, a target is illuminated during a night operation or under darkness. The illuminator **230** acts as a flashlight to shine light on the target so that the target becomes visible to a naked eye or via the video image from the camera **220**. For example, when an IR light is emitted from the illuminator **230**, the camera **220** is able to obtain an image of the object being shined by the IR light.

In the digital module **200** shown in FIGS. **11-13**, the camera **220** and the illuminator **230** are arranged side by side in a horizontal direction. Nevertheless, in other embodiments of the invention, the camera **220** and the illuminator **230** may be arranged vertically, so that the camera **220** is stacked on top of the illuminator **230**, or vice-versa. In other arrangements according to an embodiment of the invention, the camera **220** and the illuminator **230** may be arranged diagonally from each other. For accurate shooting, the camera **220** must be installed on top of the attachment rail **130**. In addition, the camera **220** has capability to detect enemy lasers pointing at users of the DMO providing an early warning to take cover prior to a possible fire power. An IR warning sign will be displayed on a head mounted display (HMD) to save lives.

The digital module **200** may be aligned to the bullet drop compensation mount **100**, so that they may be attached to each other by way of the receiving groove **215** of the digital module **200** being fitted onto the attachment rail **130** of the bullet drop compensation mount **100** by sliding onto the attachment rail **130**. Using the front pin **217** and the back pin **218**, the digital module **200** is secured to the bullet drop compensation mount **100**.

Various devices may be used with the digital module **200** by attachment through the at least one of the rails **211-213** (where the rail **213** is an optional rail), such as a small dot sight, which may be used as an aiming device in case of the digital module failure. In embodiments of the invention, each of the rails **211-213** may be a picatinny rail. Other devices include laser pointers, illuminators (or flashlights), laser range finders, night vision devices, thermal cameras or others.

Hereinafter, an optical module **300** will be discussed. FIGS. **14** and **15** show various views of an optical module according to an example embodiment of the invention, whereby FIG. **14** shows a perspective view of a right front side of an optical module according to an example embodiment of the invention; and FIG. **15** shows a perspective view of a right back side of the optical module according to an example embodiment of the invention.

An optical module **300** according to an example embodiment of the invention includes a window frame **310** supporting a transparent lens **314** and one or more rails **311-313**, and a platform **316** containing a receiving groove **315**. In greater detail, the window frame **310** supports a top rail **312** and two side rails **311** and **313**, but the number of the rails **311-313** may vary depending on various factors, such as a size of the window frame **310** and number of attachments to be provided to the optical module **300**.

FIG. **14** shows a shape of the transparent lens **314** as a rounded pentagon shape, but other examples of the shapes of the transparent lens **314** may include a rectangular shape, windshield shape, trapezoid shape, lens shape, oval shape, and octagonal shape, and may also include additional room on each side to display target information. For example, data such as the distance from a laser range finder, IR detector, wind, elevation, and other necessary data to enhance a shooter's precision can be displayed on the transparent lens **314**, such as on the sides (e.g., left or right), as target information. In embodiments of the invention, the target information may be displayed anywhere on the transparent lens **314**.

Further, when a light, such as a light of red color (or any other color), is made incident on the transparent lens **314**, a dot or a shape (or a pattern) is displayed on an incident surface of the transparent lens **314** so that a shooter simply needs to align the dot or the shape over a target for accurate targeting or sighting. The window frame **310** may host a protective window, filter or honeycomb to protect the transparent lens **314** and to protect users from enemy snipers. A filter or a honeycomb will reduce reflections from the transparent lens **314** and also reduce brightness of the dot or shape to thereby reduce a risk of detection.

In embodiments of the invention, the dot or shape that is displayed on the incident surface of the transparent lens **314** may be a reticle in a similar manner as discussed above for the digital module **200**.

Various devices may be used with the optical module **300** by attachment through the at least one of the rails **311-313**, such as a dazzler laser, which may be used as a self protection device. In embodiments of the invention, each of the rails **311-313** may be a picatinny rail. Other devices include laser pointers, illuminators (flashlights), laser range finders, night vision devices, thermal cameras or others.

The platform **316** is formed integrally with the window frame **310**, and thereby supports the optical module **300**. The receiving groove **315** is formed so as to fit onto the attachment rail **130** of the bullet drop compensation mount **100** to secure placement of the optical module **300** onto the bullet drop compensation module **100**. Two pins **323** and **324** are used to secure or lock the optical module **300** into the bullet drop compensation mount **100**, but the number thereof need not be limited to two.

The optical module **300** according to an example embodiment of the invention also includes electronic components such as a battery case **322**, two switches **318** and **319**, a light emitting diode (LED) module **317**, a circular hole **321** to allow access to the elevation knob **121**, and an optical body **320**. The optical body **320** is an open design to prevent accumulation of foreign objects such as rain or snow or dirt that might interfere with the LED module **317** from projecting a reticle to the transparent lens **314**.

Hereinafter, a digital machinegun optic (DMO), which is a modularly combined bullet drop compensation mount **100** and digital module **200**, will be discussed. FIG. **16** shows a perspective view of a right back side of the bullet drop compensation mount and the digital module prior to attachment according to an example embodiment of the invention. FIG. **17** shows a perspective view of a right back side of the bullet drop compensation mount and the digital module after attachment according to an example embodiment of the invention. When combined, the bullet drop compensation module **100** and the digital module **200** forms the digital machinegun optic (DMO) **1200**.

As shown in FIG. **16**, the digital module **200** may be aligned to the bullet drop compensation mount **100**, so that they may be attached to each other by way of the receiving groove **215** of the digital module **200** being fitted onto the attachment rail **130** of the bullet drop compensation mount **100** by sliding onto the attachment rail **130**. FIG. **17** shows the completed attachment of the platform **216** to the attachment groove **130**. By using the two pins **217** and **218**, the digital module **200** is properly attached and secured to the bullet drop compensation mount **100**.

It is particularly noted that the placement of the camera **220** in the digital machinegun optic **1200** is such that a center of the camera **220** is aligned vertically with a vertical line that is defined by a center of the adjustment knob **153** and a center of the attachment rail **130**. Accordingly, the center of the adjustment knob **153**, the center of the attachment rail **130** and the center of the camera **220** are aligned vertically.

Hereinafter, a universal machinegun optic (UMO), which is a modularly combined bullet drop compensation mount **100** and optical module **300**, will be discussed. FIG. **18** shows a perspective view of a right front side of the bullet drop compensation mount and the optical module prior to attachment according to an example embodiment of the invention. FIG. **19** shows a perspective view of a right back side of the bullet drop compensation mount and the optical module after attachment according to an example embodiment of the invention. When combined, the bullet drop compensation module **100** and the optical module **300** forms the universal machinegun optic (UMO) **1300**.

As shown in FIG. **18**, the optical module **300** may be aligned to the bullet drop compensation mount **100**, so that they may be attached to each other by way of the receiving groove **315** of the optical module **300** being fitted onto the attachment rail **130** of the bullet drop compensation mount **100** by sliding onto the attachment rail **130**. FIG. **19** shows the completed attachment of the platform **316** to the attachment groove **130**.

It is particular noted that the placement of the transparent lens **314** in the universal machinegun optic (UMO) **1300** is such that a center of the transparent lens **314** is aligned vertically with a vertical line that is defined by a center of the adjustment knob **153** and a center of the attachment rail **130**. Accordingly, the center of the adjustment knob **153**, the center of the attachment rail **130** and the center of the transparent lens **314** are aligned vertically.

Hereinafter, a digital machinegun optic (DMO) used with a head mounted display (HMD) will be discussed. FIG. **20** shows a digital machinegun optic attached to a head mounted display (HMD) according to an example embodiment of the invention.

FIG. **20** shows a complete/integrated solution **1250** that includes the digital machinegun optic (DMO) **1200**, a cable (shown as two portions **1220** and **1230**), a power pack/control box module (or an external controller) **1210**, and a head mounted display module **1240** having a connection portion **1241** and a display portion (or an external display device) **1242**. Hereinafter, the display portion **1242** is referred to as a head mounted display (HMD) **1242**. In operation, an obtained image data is transmitted to the external controller **1210** and to the head mounted display (HMD) **1242** via the cable **1220** and **1230** attached to the mil-connector **213** to enable a shooter to accurately take aim at a target using the above discussed reticles that are displayed on the head mounted display (HMD) **1242** so that a shooter simply needs to ensure that the reticle aligned over the target for accurate targeting or sighting. That is, to align the reticle over the target, the bullet drop compensation mount **100** of the digital machinegun optic (DMO) **1200** is manipulated to control for a proper bullet drop compensation. Accurate distance information can be obtained by using a laser range finder, for example, and information about a target may be displayed on the head mounted display (HMD) **1242**. The head mounted display (HMD) **1242** is detachable from a goggle configuration. Accordingly, the head mounted display (HMD) **1242** may be attached to any surface, such as a helmet or even a transparent shield. The head mounted display (HMD) **1242** may be a display screen that is attached to (or formed in) the digital module **200** or the digital machinegun optic (DMO) **1200** in other embodiments of the invention.

In embodiments of the invention, the control box module **1210** allows users to turn on/off the DMO, to select a reticle, to select the right zoom, to display warning sign for laser detection and to control brightness of the head mount display (HMD) **1242**. Using a control box module **1210**, a user can easily select a desired reticle and a magnification for maximum flexibility and increased performance in the field. The control box module **1210** provides an ability to switch in a split second from Close Quarters Battle setting to a semi-sniping setting and vice versa. In addition, it can be used as a discrete target observation and identification device.

In embodiments of the invention, the control box **1210** allows users to store video images to a fixed or removable storage device for after action review or training purpose.

Captured high quality video images are displayed in real time on the user's eye-piece or the head mounted display (HMD). In addition, the head mount display (HMD) **1242** can display selected reticle, magnification and Laser detection or warning. The HMD allows the shooter to remain under or behind a crew served infantry weapon during battlefield conditions and still effectively engage enemy targets.

In embodiments of the invention, the digital machinegun optic (DMO) **1200** may be connected to (or communicate with) the head mounted display (HMD) **1242** via wireless technology. A power to the HMD may be provided by a dedicated battery pack. A power to the DMO may be provided by a separate battery pack or from a vehicle power supply.

Although example embodiments have been described with reference to a number of illustrative examples, it should be understood that numerous other modifications and changes can be devised by those skilled in the art that will fall within the scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

What is claimed is:

1. A digital machinegun optic (DMO) with a modular design, the DMO comprising:

a digital module having a camera to obtain an image;

a bullet drop compensation mount receiving the digital module in a detachable manner, and having a mounting solution, a caliber adjustment knob configured to enable a user to select a caliber that matches firearms of different calibers, and a dual bullet drop compensation wheel to allow the user to accurately hit a target by selecting a right distance to the target;

a head mounted display module having a display portion to receive the image from the camera; and

a control box module configured to control a display of the image on the display portion.

2. The DMO of claim **1**, wherein the digital module further has one of an infrared (IR) illuminator and a laser illuminator to allow the camera to obtain the image during a night operation.

3. The DMO of claim **1**, wherein the control box module further includes a built-in a storage device.

4. The DMO of claim **1**, wherein the mounting solution comprises a plurality of bolts configured to attach the DMO to the firearms of different calibers.

5. The DMO of claim **4**, wherein the different calibers include 5.56 mm, 7.62 mm, 8.6 mm, 12.7 mm, and 20 mm calibers.

6. The DMO of claim **5**, wherein the caliber adjustment knob is a dual caliber selector that adjusts between 5.56 mm and 7.62 mm calibers, 7.62 mm and 12.7 mm calibers, and 12.7 mm and 20 mm calibers.

7. The DMO of claim **1**, wherein the caliber adjustment knob is a dual caliber selector that adjusts between any two calibers chosen from 5.56 mm, 7.62 mm, 8.6 mm, 12.7 mm, and 20 mm calibers.

8. The DMO of claim **1**, wherein the dual bullet drop compensation wheel corresponds to one set of two calibers, and is exchangeable with another dual bullet drop compensation wheel corresponding to another set of two calibers.

9. The DMO of claim **1**, wherein the bullet drop compensation mount includes an attachment rail configured to receive one of the digital module, an optical module, and a thermal camera module for attachment.

10. The DMO of claim **1**, further comprising at least one rail to receive at least one of a dazzler laser, a flash light, a laser range finder, and a laser pointer.

11. The DMO of claim **1**, wherein the display portion displays at least one reticle from among a choice of three reticle for sighting the target, the three reticles being selectable by the user to match a specific mission.

12. The DMO of claim **1**, wherein the display portion displays targeting information of the target.

13. The DMO of claim **1**, wherein the bullet drop compensation module includes an attachment rail to receive the digital module for attachment, and a center of the camera is aligned vertically with a vertical line that is defined by a center of the adjustment knob and a center of the attachment rail.

14. The DMO of claim **1**, wherein the camera is configured to detect enemy lasers to enable a warning sign to be displayed on the display portion.

15. The DMO of claim **1**, wherein the DMO is a universal machine gun optic enabling use of one machinegun optic for all medium and heavy machineguns using the dual bullet drop compensation wheel.

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